Northeast Fisheries Science Center Reference Document 13-26

Description of the 2012 Oceanographic Conditions on the Northeast U.S. Continental Shelf

by Paula S. Fratantoni, Tamara Holzwarth-Davis,
Cristina Bascuñán, and Maureen H. Taylor

September 2013

Northeast Fisheries Science Center Reference Document 13-25

Description of the 2012 Oceanographic Conditions on the Northeast U.S. Continental Shelf

by Paula S. Fratantoni, Tamara Holzwarth-Davis, Cristina Bascuñán and Maureen H. Taylor

NOAA's National Marine Fisheries Serv., 166 Water St., Woods Hole MA 02543

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

September 2013

Northeast Fisheries Science Center Reference Documents

This series is a secondary scientific series designed to assure the long-term documentation and to enable the timely transmission of research results by Center and/or non-Center researchers, where such results bear upon the research mission of the Center (see the outside back cover for the mission statement). These documents receive internal scientific review, and most receive copy editing. The National Marine Fisheries Service does not endorse any proprietary material, process, or product mentioned in these documents.

All documents issued in this series since April 2001, and several documents issued prior to that date, have been copublished in both paper and electronic versions. To access the electronic version of a document in this series, go to *http://nefsc.noaa.gov/publications/*. The electronic version is available in PDF format to permit printing of a paper copy directly from the Internet. If you do not have Internet access, or if a desired document is one of the pre-April 2001 documents available only in the paper version, you can obtain a paper copy by contacting the senior Center author of the desired document. Refer to the title page of the document for the senior Center author's name and mailing address. If there is no Center author, or if there is corporate (*i.e.*, non-individualized) authorship, then contact the Center's Woods Hole Laboratory Library (166 Water St., Woods Hole, MA 02543-1026).

Information Quality Act Compliance: In accordance with section 515 of Public Law 106-554, the Northeast Fisheries Science Center completed both technical and policy reviews for this report. These predissemination reviews are on file at the NEFSC Editorial Office.

This document may be cited as:

Fratantoni PS, Holzwarth-Davis T, Bascuñán C, Taylor MH. 2013. Description of the 2012 Oceanographic Conditions on the Northeast U.S. Continental Shelf. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 13-26; 40 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://nefsc.noaa.gov/publications/

Contents

List of Tables

List of Figures

Appendix

Abstract

Hydrographic observations from twelve surveys spanning the Northeast U.S. Continental Shelf are combined into a descriptive overview of the broad-scale oceanographic conditions that were observed during 2012. Temperature and salinity observations are combined into six 2-month time periods in order to maximize both the spatial coverage of the data and its temporal resolution during the year. Maps of near-surface and near-bottom property distributions are presented for each bi-monthly period and time series of regional average properties are discussed for five geographic regions spanning the shelf: western Gulf of Maine, eastern Gulf of Maine, Georges Bank, and northern and southern Middle-Atlantic Bight. The entire Northeast U.S. Continental Shelf was warm in 2012 relative to the reference period (1977-1987), with warm conditions penetrating to the bottom over much of the region. Warming was greatest during the late winter in the southern Middle Atlantic Bight, peaking during summer elsewhere. Bottom waters in the Middle Atlantic Bight Cold Pool were warmer and this feature was slower to erode in the fall, perhaps due to enhanced stratification brought on by warmer surface conditions in the preceding spring/summer. Conditions in the Gulf of Maine were also warm, driven by atmospheric heating at the surface and by the advection of a warmer/saltier variety of slope water mass at depth. Like the Cold Pool in the Middle Atlantic Bight, the Cold Intermediate Layer in the Gulf of Maine was warmer during the spring of 2012, presumably a consequence of a less developed and warmer winter mixed layer during the preceding winter.

Introduction

The Northeast Fisheries Science Center (NEFSC) conducts multiple surveys on the Northeast U.S. continental shelf each year in support of its ongoing mission to monitor the shelf ecosystem and assess how its components influence the distribution, abundance, and productivity of living marine resources. In support of this mission, the Oceanography Branch provides conductivity, temperature, and depth (CTD) instruments to all NEFSC cruises for the measurement of water column profiles of temperature and salinity. In addition to providing oceanographic context to specific field programs, these data contribute to a growing database of historical measurements that are used to monitor seasonal and interannual variability in the water properties on the northeast continental shelf.

Broad-scale surveys, sampling the shelf from Cape Hatteras, North Carolina, into the Gulf of Maine, are conducted up to six times per year, during shelf-wide spring and fall bottom trawl surveys and typically on four dedicated seasonal Ecosystem Monitoring (EcoMon) surveys. Profiles of conductivity, temperature, and depth are collected at each station on these shelf-wide surveys. Observations are also collected on other more regionally focused NEFSC surveys, where station coverage varies depending on the objectives of the particular field program. During 2012, hydrographic data were collected on 12 individual NEFSC cruises, amounting to 1,902 profiles of temperature and salinity (Table 1). Here we present an annual summary of these observations, including surface and bottom distributions of temperature and salinity, as well as their anomalies relative to a consistent reference period. In addition, regional average values of temperature and salinity and their anomalies are computed for five different regions of the shelf during six bi-monthly periods. Finally, the volume and properties of the shelf water are examined for the Middle-Atlantic Bight region.

Data and Methods

The Oceanography Branch provides CTD instrumentation and support to all NEFSC programs requesting this service. Training in instrument maintenance and operation -- including deployment, data acquisition, recovery and preliminary processing -- is provided as needed prior to sailing. On NEFSC surveys, CTD instruments are typically deployed in one of two modes: (1) during a bongo net tow, the CTD instrument is mounted on the conducting wire above the bongo frame and data are collected as a double oblique profile with the ship steaming at approximately 2 knots; or (2) during a non-net tow, the CTD is mounted vertically on the wire and the sensors are soaked for one minute at the surface prior to descent. The sensors are not soaked at the surface prior to descent during bongo tows, rendering the upper 30 meters or more of the downcast unreliable. For this reason, the up-cast profile data are routinely processed as the primary data for each station.

In 2012, hydrographic data were collected aboard the NOAA ships *Delaware II* and *Henry B. Bigelow*, the F/V *Eagle Eye II*, and the R/V *HR Sharp*, using a combination of Seabird

Electronics SBE-19 and SBE-19+ SEACAT profilers and SBE 9/11 CTD units (Table 1). All raw CTD profile data were processed ashore, using standard Seabird Electronics software to produce 1-decibar averaged profiles in ascii-formatted files. Water samples were collected twice daily at sea during vertical casts. Following each cruise, these samples were analyzed using a Guildline AutoSal laboratory salinometer to provide quality control for the CTD salinity data. A salinity offset was applied to instrument data if the mean difference between the reference Autosal readings and the CTD values exceeded +/- 0.01 (a threshold chosen based on the expected instrument accuracy). Vertical density profiles were examined for inversions due to bad conductivity or temperature readings and/or sensor misalignment. Egregious cases were replaced with a flag value. The processed hydrographic data were loaded into ORACLE database tables and made publically available via anonymous ftp (ftp://ftp.nefsc.noaa.gov/pub/hydro). Cruise reports have been prepared for each survey listed in Table 1 and are available online (http://www.nefsc.noaa.gov/epd/ocean/MainPage). Readers are referred to the individual cruise reports for notes, property maps and aggregate data specific to a particular survey.

Here, we aim to provide a descriptive overview of the hydrographic sampling that was conducted in 2012 and to characterize the broad-scale oceanographic conditions that were observed. In order to maximize both the spatial coverage of the data and its temporal resolution, the processed 2012 CTD data have been sorted into six 2-month time bins. Maps of near-surface and near-bottom temperature and salinity have been produced from profile data falling within each 2-month period. Surface fields include the shallowest observed temperature/salinity at each station that is also in the upper 5 meters of the water column, while bottom maps include the deepest observation at each station that also falls within 10 meters of the reported water depth. In order to examine the spatial and temporal variability over broader areas of the shelf, average values have been computed from the data within five sub-regions spanning the Northeast U.S. Continental Shelf (Figure 1). Regional averages have been computed for the bi-monthly binned fields (Tables 1 and 2) and for individual cruises (Appendix Tables 1-5).

In order to characterize variability that is not related to seasonal forcing, anomalies have been calculated at each station relative to a standard reference period (1977-1987). During this period, the NMFS Marine Resources Monitoring and Prediction (MARMAP) program repeatedly occupied stations spanning the entire Northeast U.S. Shelf so that an annual cycle could be constructed for water properties across all regions of the northeast shelf (Mountain et al. 2004; Mountain and Holzwarth 1989). The anomalies presented here are defined as the difference between the observed 2012 value at individual stations and the expected value for each location and time of year based on this reference period. Similarly, regional anomalies are the area-weighted average of these anomalies within a given domain. The methods used and an explanation of uncertainties are presented in Holzwarth and Mountain (1990).

Finally, we calculate the temperature, salinity and volume of the shelf water in the Middle-Atlantic Bight during 2012 and relate this to the conditions observed during the MARMAP reference period. Following Mountain (2003), the shelf water mass is defined as water within the upper 100 meters having salinity less than 34. For each survey in 2012, the area of a sub-region was apportioned among its stations by an inverse distance squared weighting. The shelf water volume at a given station is the thickness of the shelf water at the station multiplied by its apportioned area, and the total shelf water volume within the sub-region is the sum of these products for all stations within the region. Similarly, the average temperature and salinity was calculated in the shelf water layer at each station and multiplied by the total shelf water volume for that station. The sum of these products over all stations within a given sub-region, divided by the total shelf water volume for the region, determines the volume-weighted average temperature and salinity. Anomalies in the property and volume of the shelf water mass are calculated relative to like variables derived from MARMAP hydrographic data, as described above. Hence, here regional anomalies are computed as the mathematical difference between regional averages, *not* an average of the anomalies computed for a given sub-region.

Results

Table 1 provides a listing of the NEFSC cruises that collected hydrographic data in 2012. In total, 1,902 profiles of temperature and salinity were collected, processed, and archived during the year. Combining the hydrographic data from multiple cruises into bi-monthly bins improves the spatial coverage compared with that of individual surveys, enabling us to examine the spatial and temporal patterns in hydrography over the region. Nonetheless, there are still significant gaps in several of the bi-monthly distribution maps shown in Figure 2. For instance, poor coverage in the Gulf of Maine during May-June was a consequence of mechanical problems on the F/V *Bigelow* that led to lost sea days during the June Ecosystem Monitoring (EcoMon) cruise. The gap in station coverage in the northern Middle Atlantic Bight (MAB) during November-December results from a misalignment between this bi-monthly period and the Fall EcoMon survey that began in October, sampling first in the northern MAB. Large gaps in station coverage preclude the calculation of a true area-weighted regional average surface/bottom temperature and salinity value during May/June in the Gulf of Maine and during November/December in the MAB (Tables 2 and 3; Figures 3 and 4). These cases are flagged in Tables 2 and 3 and the reader should keep this in mind when interpreting results.

Ocean temperatures across the NEUS shelf were warm throughout 2012 relative to the reference period (Figure 3). While warming persisted throughout the year, the seasonal pattern suggests that springtime warming began earlier in 2012 compared with previous years, particularly in the south. In the MAB, warming was most pronounced during late winter at both surface and bottom (Figure 3). The similar seasonal patterns of warming near the bottom imply that heat input at the surface was efficiently redistributed vertically through regional mixing processes. In the Gulf of Maine and Georges Bank, surface warming was twice as large during summer compared with other seasons, suggesting an increase in the seasonal temperature range in these regions (Figure

3). However, this seasonal pattern did not penetrate to the bottom, where instead waters were consistently warm throughout the year. For the Gulf of Maine, this is reflective of the fact that bottom waters are largely insulated from atmospheric forcing, making it more likely that the warming here is driven by advection.

The salinity on the NEUS Shelf was near normal over most of the year (Figure 4). Except in the southern MAB, surface waters began the year slightly fresh and ended the year slightly salty. Similar trends were observed near the bottom over Georges Bank but were not apparent elsewhere. For instance, bottom waters in the Gulf of Maine were slightly salty through most of the year, with a slight increase into fall. Shelf water in the MAB is defined as waters having salinity less than 34, and the volume of this water mass was near normal in 2012 relative to the MARMAP period (Figure 5). This suggests that the shelf/slope front, a ubiquitous feature that marks the transition between colder/fresher shelf water onshore and warmer/saltier water offshore, was consistently located near the long-term average position. On average, the shelf water properties follow the temporal trends observed for the full region (Figures 3 and 4), suggesting that the observed warming in the MAB during 2012 did not result from changes in the volume of shelf water transported through the region.

Details related to the regional averages in Figures 3 and 4 are explored in surface and bottom property distribution maps (Figures 6-11). Maps of surface temperature reveal the seasonal cycle of warming and cooling over the region, with warmest temperatures observed at the surface beginning first in the south during early summer, followed by bottom waters near shore in the MAB and over Georges Bank, and finally at the surface in the Gulf of Maine (Figure 6-11a). Even though regional averages indicate warming over most of the region relative to the MARMAP reference period (Figure 3), the details of this warming vary from region to region. For example, the late-winter warming observed in the MAB was enhanced near shore, and similarly strong at the surface and bottom in these shallow regions (Figure 7b). However, by July/August at the peak of seasonal heating (Figure 3), a cross-shelf temperature gradient had formed in the southern MAB, with slightly cooler water observed inshore of warmer water at the surface (Figure 9a). While the cross-shelf gradient was reversed near the bottom (Figure 9a), temperatures were actually 2-3°C colder than average over the entire water column in this near shore region (Figure 9b).

In the Gulf of Maine, surface temperature anomalies were largest during the period of peak seasonal heating (July/August), particularly over the shallow banks and shelves, including Georges Bank (Figure 9b). While bottom waters were also warm throughout the year in the Gulf of Maine, the anomalies were much smaller and their spatial distribution was different from the surface. This is not surprising, as bottom water properties over much of the Gulf of Maine are decoupled from surface forcing.

Maps of near-bottom temperature show the seasonal formation of the cold pool in the MAB, with coldest temperatures observed during the May/June period (Figure 8a). The accompanying maps of near-bottom temperature anomaly suggest that temperatures in the Cold Pool were between 1-3°C warmer in 2012 (Figure 8b). The Cold Pool begins to break down with the onset of vertical mixing induced by fall cooling and storm activity. In 2012, the cold pool had begun to weaken and warm by September/October (Figure 10a). However, bottom waters in the Cold Pool were actually slightly cooler than average during this period (Figure 10b), suggesting that the feature persisted longer than normal during 2012. This may be a consequence of the anomalously strong stratification that characterized summer 2012 (Figure 12), thereby inhibiting the vertical mixing that would lead to erosion of the Cold Pool.

Overall, the NEUS Shelf was near normal to slightly salty in 2012, with the largest anomalies concentrated near the shelfbreak, particularly during fall (Figures 10-11b). The enhanced fall anomalies can be traced to the presence of a large Gulf Stream meander, visible in satellite sea surface temperature imagery and confirmed by the T-S character of the deep water in the Northeast Channel (Figure 13). Gulf Stream influences aside, deep inflow through the Northeast Channel was warm and salty throughout 2012 (Figure 14), near the upper limit of the historical range (Figure 13), and this warm/salty trend was observed throughout the Gulf of Maine (Figures 3, 4, 10b, and 11b). In fact, springtime temperature-salinity profiles indicate that the Cold Intermediate layer in the Gulf of Maine, a mid-depth water mass formed seasonally as a product of convective mixing driven by winter cooling, was also warmer and saltier (and less pronounced, having a weaker temperature minimum) during 2012 (Figure 15). This may be a consequence of weaker convective mixing leading to shallower mixed layers during the preceding winter. Indeed, winter mixed layers during 2012 were only half as deep and up to 1.5°C warmer than those observed during 2008 (Figure 16). The cause of 2012's underdeveloped mixed layers is unknown, although the stratification of the water column at the beginning of winter and the intensity of atmospheric cooling will both be important factors. In general, deeper vertical mixing has greater potential to tap into nutrient-rich slope water at depth, and should result in a thicker intermediate layer during spring, both potentially having an impact on the timing or intensity of spring phytoplankton blooms.

Large-scale atmospheric and oceanic indicators mirror the pattern of warming observed on the NEUS shelf. During 2012, annual average surface air temperatures were 1-2°C warmer than average (1981-2010) over the entire Northwest Atlantic, with anomalies reaching 2°C along the North American continent. Sea surface temperatures were also above normal over the majority of the North Atlantic, with enhanced warming along the western boundary south of Newfoundland (Figure 17). On the NEUS shelf, the average SST was the highest in the 160-year long record, exceeding previous record highs observed between 1940-1950. In fact, the NEUS shelf sea surface warmed by more than 1°C between 2011 and 2012, marking one of the largest year-to-year changes on record (Figure 18).

There is some indication that the warm atmospheric conditions were driven by an asymmetry in the seasonal cycle relative to long-term average conditions. Based on the climate summaries compiled by the Northeast Regional Climate Center (http://www.nrcc.cornell.edu), monthly mean air temperatures over the Northeastern U.S. were almost 3ºF warmer than the long term mean during 2012 (referenced to 1971-2000). Monthly average air temperatures consistently exceeded average values by 5ºF throughout the winter and spring, reading almost 10ºF warmer during March (Figure 19). This is consistent with the observation that the NEUS shelf was warmest in March/April (Figure 7b).

According to Northeast Regional Climate Center records, the monthly mean precipitation over the Northeastern U.S. was below normal between January and August, followed by a relatively wet fall (referenced to 1971-2000). Most notably, precipitation was elevated in October (almost 3” above normal) due to the passage of Hurricane Sandy. This enhanced precipitation may account for the anomalously fresh surface conditions observed near the Hudson River and Delaware and Chesapeake Bays in the November/December salinity anomaly maps (Figure 11b).

References

Holzwarth TJ, Mountain DG. 1990. Surface and Bottom Temperature Distributions from the Northeast Fisheries Center Spring and Fall Bottom Trawl Survey Program, 1963-1987. NEFSC Reference Document 90-03, 62 p.

Mountain DG. 2003. Variability in the properties of Shelf Water in the Middle Atlantic Bight, 1977-1999. Journal of Geophysical Research, 108, 3014, doi:10.1029/2001JC001044, (14-)1-11.

Mountain DG, Holzwarth TJ. 1989. Surface and Bottom Temperature Distribution for the Northeast Continental Shelf. NOAA Technical Memorandum NMFS-F/NEC-73, 55 p.

Mountain DG, Taylor MH, Bascuñán C. 2004. Revised procedures for calculating regional average water properties for Northeast Fisheries Science Center cruises. NEFSC Reference Document 04-08, 53 p.

Northeast Regional Climate Center. Seasonal Climate Summary Tables [Internet]. Cornell University. [cited 2012 June 6]. Available from: http://www.nrcc.cornell.edu/.

Table 1. Listing of 2012 NOAA Northeast Fisheries Science Center cruises supported by the Oceanography Branch.

Cruise	Program	Dates	Region(s)[1]	Gear	Casts
DEL1201	LMRCSC/COOP	19 - 26 Jan	South MAB	SBE-19/ 19+	29
DEL1202	EcoMon	3 – 21 Feb	Full Shelf	SBE-19+	170
HB1201	Spring Bottom Trawl	29 Feb - 4 May	Full Shelf	SBE-19	374
DEL1203	N. Right Whale	15-29 Mar	W. GOM	SBE-911+	76
UN1201	Apex Predator	11 Apr - 17 May	SAB	SBE-19+,/911+	47
DEL1205	N. Right Whale	1 - 21 May	W. GOM	SBE-19/ 19+	80
HB1202	EcoMon	31 May - 3 Jun	MAB, GB	SBE-911+	120
S11201	Scallop	16 Jun – 6 Jul	N. MAB, GB	SBE-19+	51
HB1205	EcoMon	7 – 24 Aug	Full Shelf	SBE-19+/19	248
PC1206	Herring Acoustic	14 Sep – 18 Oct	GOM	SBE-19/19+/911+	162
HB1206	Fall Bottom Trawl	7 Sep – 10 Nov	Full Shelf	SBE-19+	376
PC1207	EcoMon	26 Oct – 13 Nov	Full Shelf	SBE-19+/911+	169

[1] Regional Abbreviation:

GOM=Gulf of Maine

GB=Georges Bank

MAB=Mid Atlantic Bight

SAB=South Atlantic Bight

Table 2. 2012 regional average surface and bottom temperature values computed from CTD data that were sorted into six 2-month time periods for the five regions of the Northeast U.S. continental shelf shown in Figure 1.

		SURFACE						BOTTOM					
Region	CD	#obs	Temp	Anomaly	SDV1	SDV2	Flag	#obs	Temp	Anomaly	SDV1	SDV2	Flag
January-February													
GOME	41	55	6.15	1.50	0.22	1.56	1	49	7.60	2.14	0.20	1.41	1
GOMW	40	12	5.98	1.28	0.25	0.90	0	10	7.61	0.50	0.27	1.13	0
GB	37	31	7.53	2.08	0.20	1.12	0	27	7.98	1.69	0.24	1.11	0
MABN	46	26	8.17	2.68	0.25	1.33	0	20	9.35	3.35	0.30	1.21	0
MABS	42	67	9.58	3.11	0.17	1.12	0	50	9.80	3.60	0.20	1.38	0
March-April													
GOME	107	97	7.28	2.28	0.15	0.74	0	96	7.01	2.02	0.12	0.76	0
GOMW	105	28	6.60	1.69	0.18	0.69	0	24	8.18	1.11	0.21	0.90	0
GB	99	65	7.21	1.93	0.14	0.80	0	51	7.11	1.86	0.17	0.90	0
MABN	85	57	8.85	4.17	0.17	1.46	0	48	8.89	3.72	0.22	1.56	0
MABS	72	75	10.55	4.49	0.15	1.49	0	64	9.91	4.13	0.21	1.38	0
May-June													
GOME	133	68	9.61	2.16	0.13	1.66	1	67	7.27	1.97	0.12	1.71	1
GOMW	140	24	10.34	2.62	0.20	3.48	1	21	8.06	0.72	0.21	3.70	1
GB	163	60	12.66	2.21	0.16	1.09	0	55	10.11	1.96	0.17	1.29	0
MABN	160	44	16.23	2.59	0.21	1.69	0	39	9.23	1.40	0.27	1.49	0
MABS	156	40	19.11	2.26	0.22	1.30	0	38	12.32	2.97	0.24	1.24	0
July-August													
GOME	230	47	20.32	3.68	0.17	1.71	0	33	8.17	1.62	0.18	2.79	1
GOMW	233	17	18.61	4.59	0.21	1.79	0	10	10.40	1.92	0.27	1.69	0
GB	219	69	18.99	3.77	0.13	1.89	0	63	12.57	1.52	0.14	1.67	0
MABN	224	44	23.47	3.33	0.21	1.74	0	40	11.48	1.72	0.23	1.41	0
MABS	224	44	25.50	1.41	0.20	2.09	0	41	12.67	0.88	0.22	2.84	0
September-October													
GOME	280	128	15.52	2.05	0.10	1.01	0	128	8.67	1.68	0.08	1.12	0
GOMW	288	52	14.87	2.18	0.16	0.92	0	51	9.55	1.23	0.17	1.41	0
GB	283	78	18.00	2.96	0.13	1.66	0	60	14.78	2.19	0.17	2.02	0
MABN	278	70	19.55	2.19	0.16	1.47	0	55	13.86	1.17	0.19	2.31	0
MABS	261	93	23.63	1.83	0.14	1.37	0	77	14.63	0.34	0.17	2.67	0
November-December													
GOME	309	43	12.87	2.09	0.17	0.70	0	41	9.46	1.80	0.15	0.97	0
GOMW	311	21	12.74	1.85	0.21	0.60	0	15	10.29	1.71	0.24	1.25	0
GB	311	25	14.93	2.09	0.20	1.26	0	23	13.81	1.94	0.23	1.46	0
MABN	316	14	14.03	0.42	0.34	2.34	1	13	14.15	1.25	0.35	3.04	1
MABS	318	46	14.01	-0.31	0.19	0.98	1	40	13.92	0.09	0.21	1.36	1

"Region", the geographic region of the northeast continental shelf: "CD", the calendar mid-date of all the stations within a region for a time period: "#obs", the number of observations included in each average: "Temp", the areal average temperature: "Anomaly", the areal average temperature anomalies: "SDV1",the standard deviation associated with the average temperature anomaly: "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived:
"Flag", a value of "1" indicates that a true areal average could not be calculated due to poor station coverage. The areal averages listed were derived from a simple average of the observations within the region.

Table 3. 2012 regional average surface and bottom salinity values computed from CTD data that were sorted into six 2-month time periods for the five regions of the Northeast U.S. continental shelf shown in Figure 1.

		SURFACE						BOTTOM					
Region	CD	#obs	Salt	Anomaly	SDV1	SDV2	Flag	#obs	Salt	Anomaly	SDV1	SDV2	Flag
						January-February							
GOME	41	55	32.64	-0.21	0.14	0.47	1	49	33.62	0.02	0.12	0.52	1
GOMW	40	12	32.58	-0.08	0.18	0.34	0	10	33.89	-0.13	0.15	0.32	0
GB	37	31	32.69	-0.25	0.13	0.37	0	27	32.88	-0.31	0.14	0.32	0
MABN	46	25	32.94	-0.25	0.17	0.54	0	20	33.40	-0.17	0.18	0.48	0
MABS	42	67	32.96	-0.52	0.13	1.12	0	50	33.51	0.02	0.12	0.59	0
						March-April							
GOME	107	97	32.40	-0.15	0.09	0.38	0	96	33.39	0.09	0.08	0.24	0
GOMW	105	28	32.17	-0.34	0.13	0.31	0	24	34.27	0.20	0.10	0.36	0
GB	99	64	32.80	-0.21	0.09	0.29	0	50	32.92	-0.24	0.11	0.32	0
MABN	85	57	32.66	-0.22	0.11	0.38	0	48	33.29	-0.08	0.13	0.50	0
MABS	72	75	32.81	-0.31	0.12	0.85	0	64	33.57	0.14	0.12	0.44	0
						May-June							
GOME	133	68	32.50	-0.18	0.08	0.55	1	67	33.51	0.13	0.07	0.53	1
GOMW	140	24	32.45	-0.14	0.13	1.06	1	21	33.89	0.14	0.12	1.15	1
GB	163	60	32.88	0.11	0.10	0.37	0	55	33.13	0.08	0.10	0.34	0
MABN	160	44	32.21	-0.16	0.14	0.40	0	39	32.81	-0.48	0.15	0.45	0
MABS	156	40	32.24	0.18	0.17	0.78	0	38	33.21	0.00	0.14	0.52	0
						July-August							
GOME	230	47	31.87	-0.08	0.11	0.36	0	33	33.17	0.15	0.10	0.51	1
GOMW	233	17	32.61	0.22	0.17	0.41	0	10	34.35	0.42	0.17	0.50	0
GB	219	69	32.65	-0.04	0.08	0.39	0	63	32.95	0.00	0.08	0.27	0
MABN	224	44	32.01	-0.35	0.13	0.58	0	40	33.12	-0.13	0.14	0.37	0
MABS	224	44	31.95	0.00	0.15	1.12	0	41	33.37	0.29	0.13	0.79	0
						September-October							
GOME	280	128	32.61	0.22	0.06	0.36	0	128	34.01	0.37	0.05	0.28	0
GOMW	288	52	33.04	0.38	0.11	0.36	0	51	34.74	0.30	0.09	0.25	0
GB	283	78	33.19	0.43	0.08	0.71	0	60	33.41	0.36	0.10	0.44	0
MABN	278	69	32.99	0.32	0.11	0.71	0	54	33.61	0.14	0.11	0.56	0
MABS	261	93	32.48	0.20	0.10	0.81	0	77	33.42	0.23	0.10	0.74	0
						November-December							
GOME	309	43	32.73	0.19	0.11	0.31	0	41	33.82	0.25	0.09	0.25	0
GOMW	311	21	32.83	0.22	0.16	0.48	0	15	34.39	0.26	0.14	0.33	0
GB	311	25	33.04	0.33	0.12	0.48	0	23	33.33	0.38	0.14	0.43	0
MABN	316	14	32.77	0.09	0.25	1.79	1	13	33.20	0.12	0.22	1.05	1
MABS	318	46	32.72	-0.23	0.14	0.70	1	40	33.04	-0.04	0.13	0.54	1

"Region", the geographic region of the northeast continental shelf: "CD", the calendar mid-date of all the stations within a region for a time period: "#obs", the number of observations included in each average: "Salt", the areal average salinity: "Anomaly", the areal average salinity anomalies: "SDV1",the standard deviation associated with the average salinity anomaly: "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived: "Flag", a value of "1" indicates that a true areal average could not be calculated due to poor station coverage. The areal averages listed were derived from a simple average of the observations within the region.

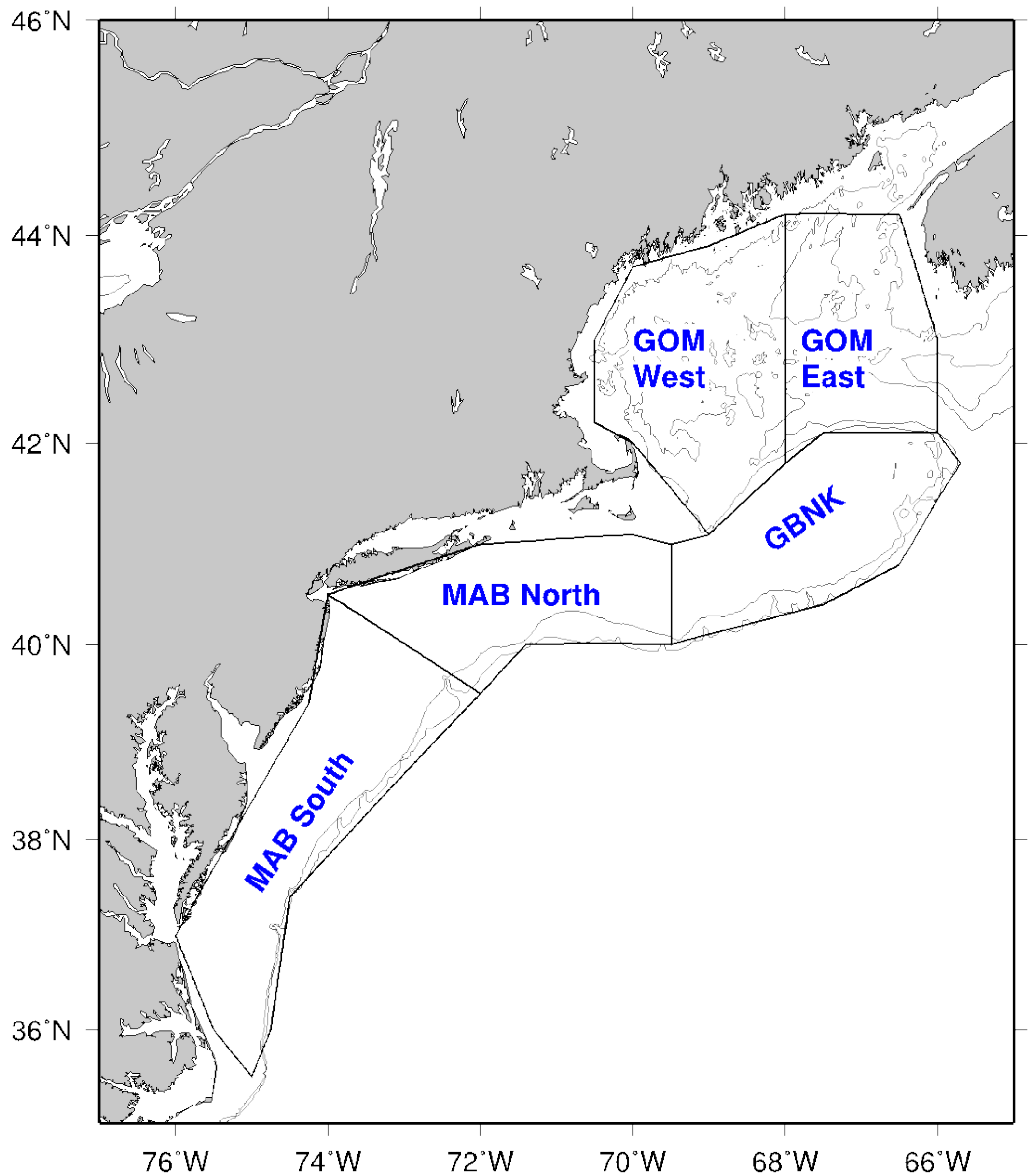

Figure 1. Region designations for the Northeast U.S. Continental Shelf. The 100 m and 200 m isobaths are also shown.

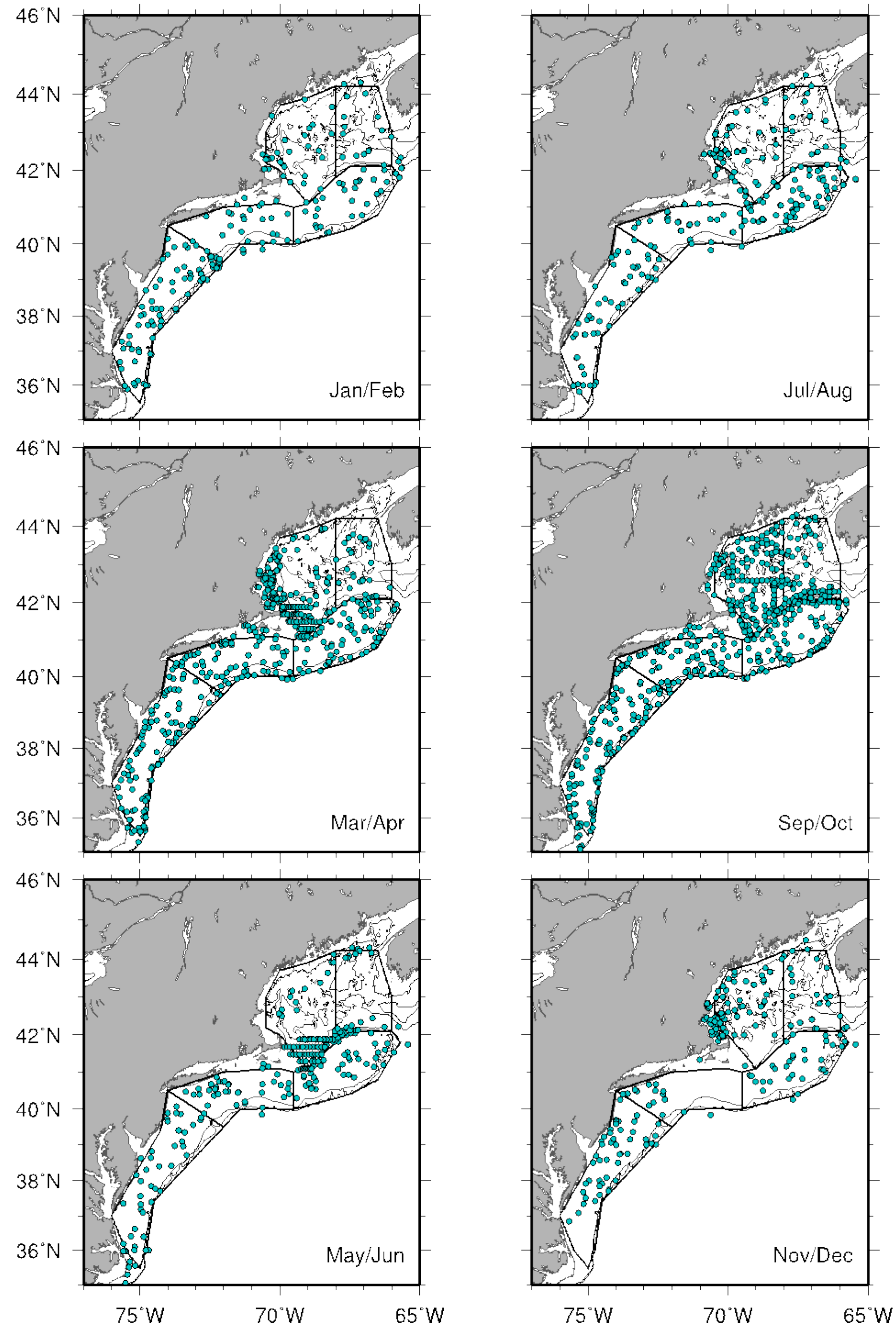

Figure 2. 2012 station distributions for each 2-month time period. The regional boundaries are also overlain. Contours correspond with the 100 and 200-meter isobaths.

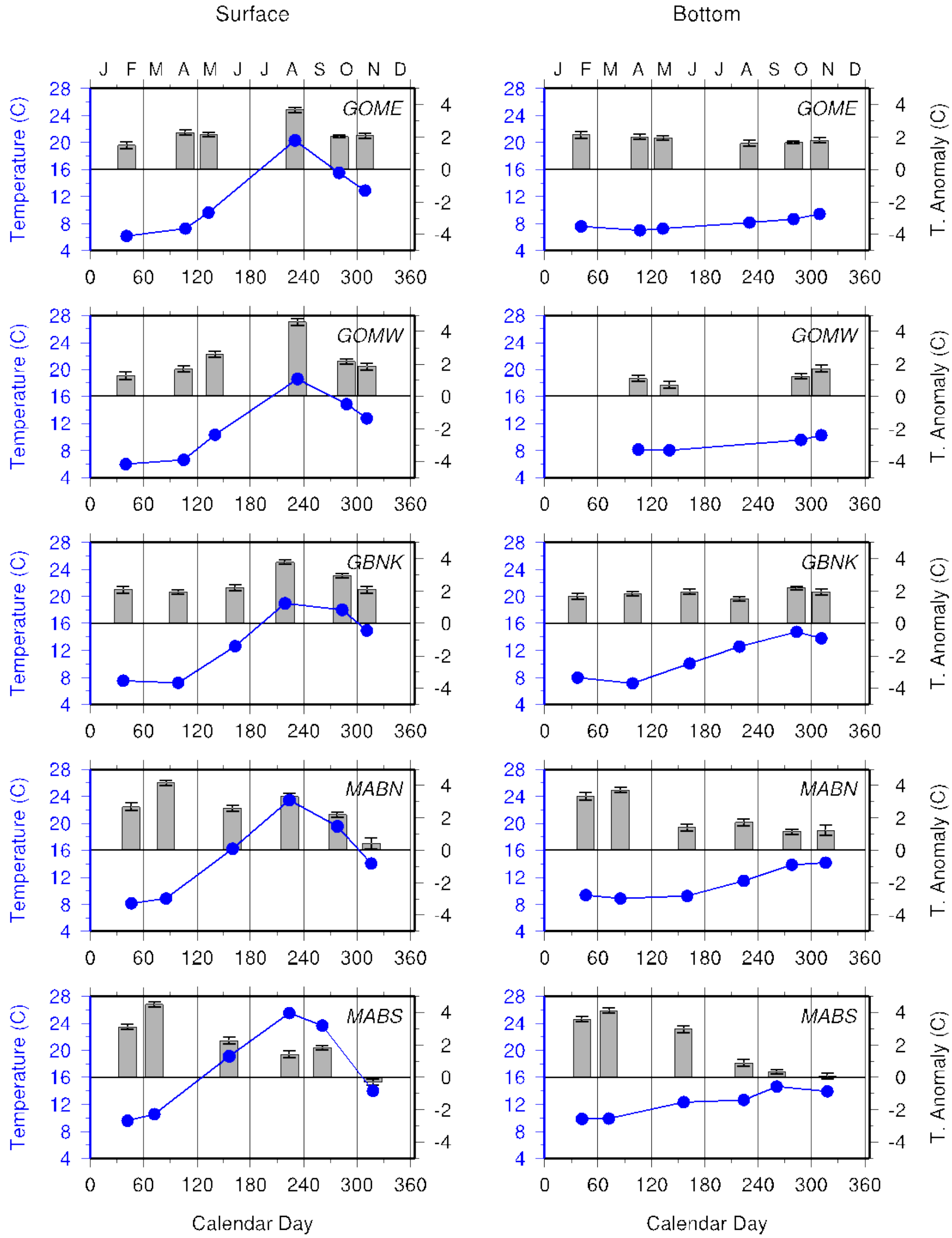

Figure 3. Time series of the 2012 regional surface (left) and bottom (right) temperatures (blue) and anomalies (bars) as a function of calendar day. Error bars are indicated for the anomaly estimates.

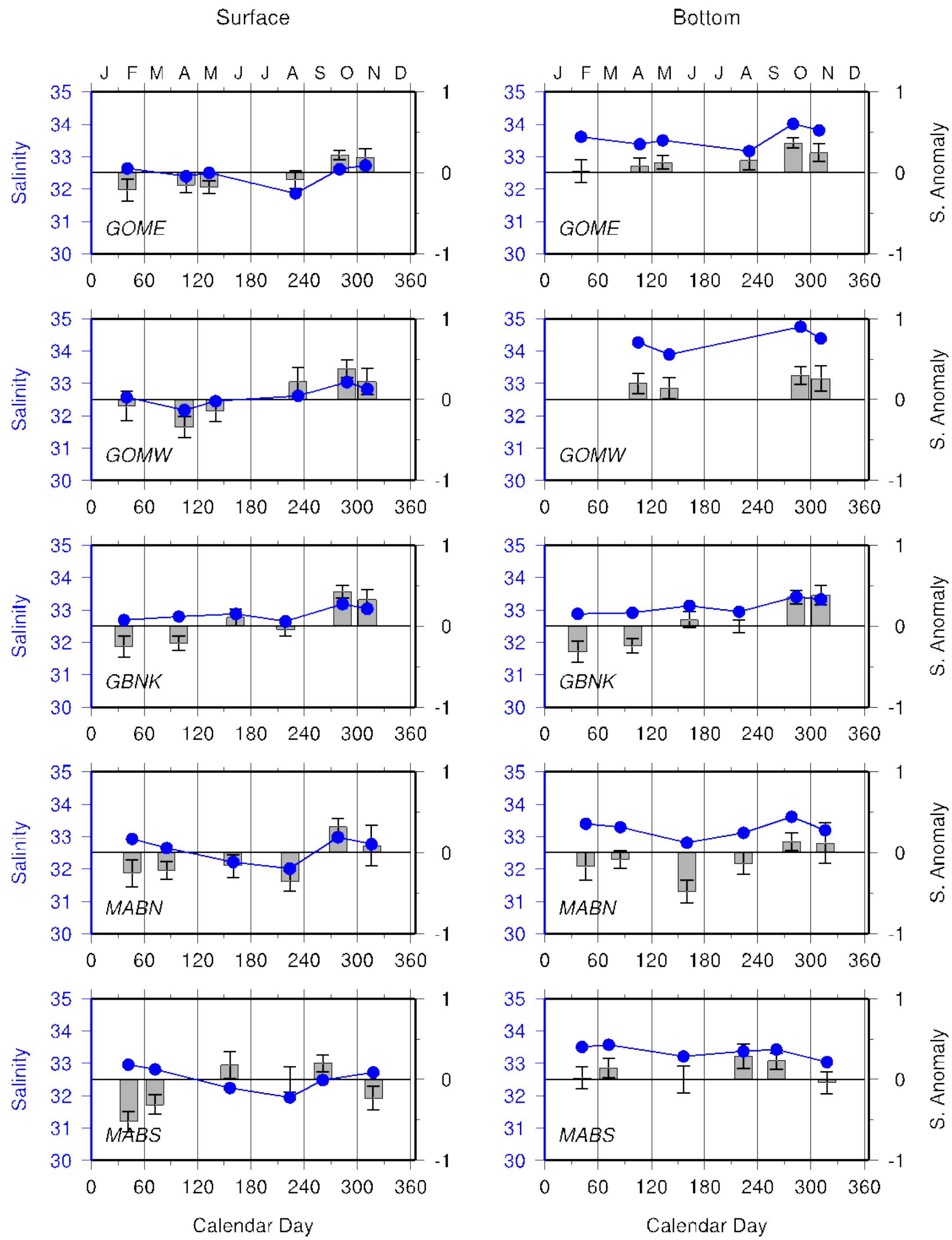

Figure 4. Time series of the 2012 regional surface (left) and bottom (right) salinities (blue) and anomalies (bars) as a function of calendar day. Error bars are indicated for the anomaly estimates.

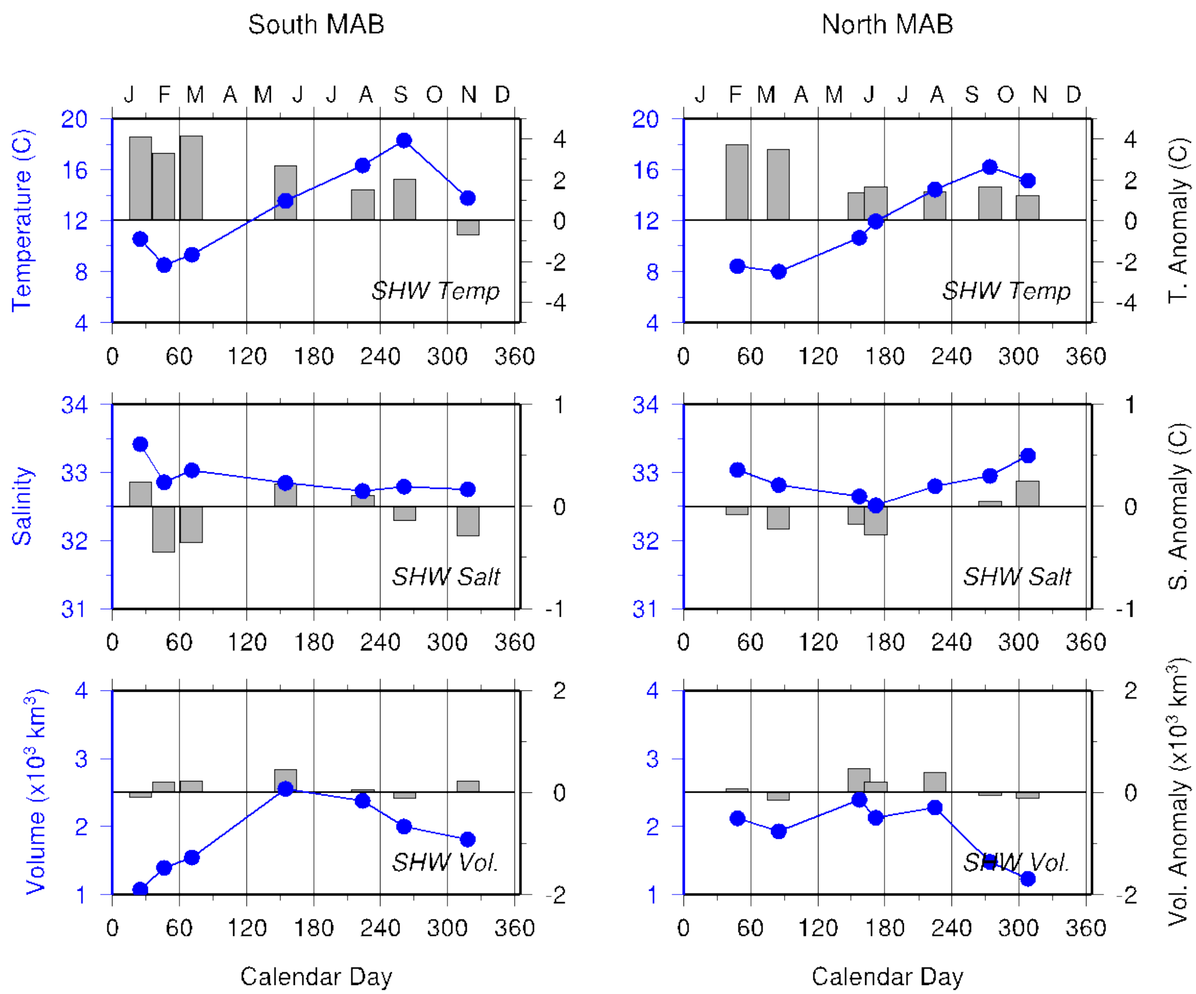

Figure 5. Time series of the 2012 regional shelf water temperature, salinity, and volume as a function of calendar day shown in blue for the southern (left) and northern (right) Middle Atlantic Bight. The vertical bars show the corresponding shelf water anomalies.

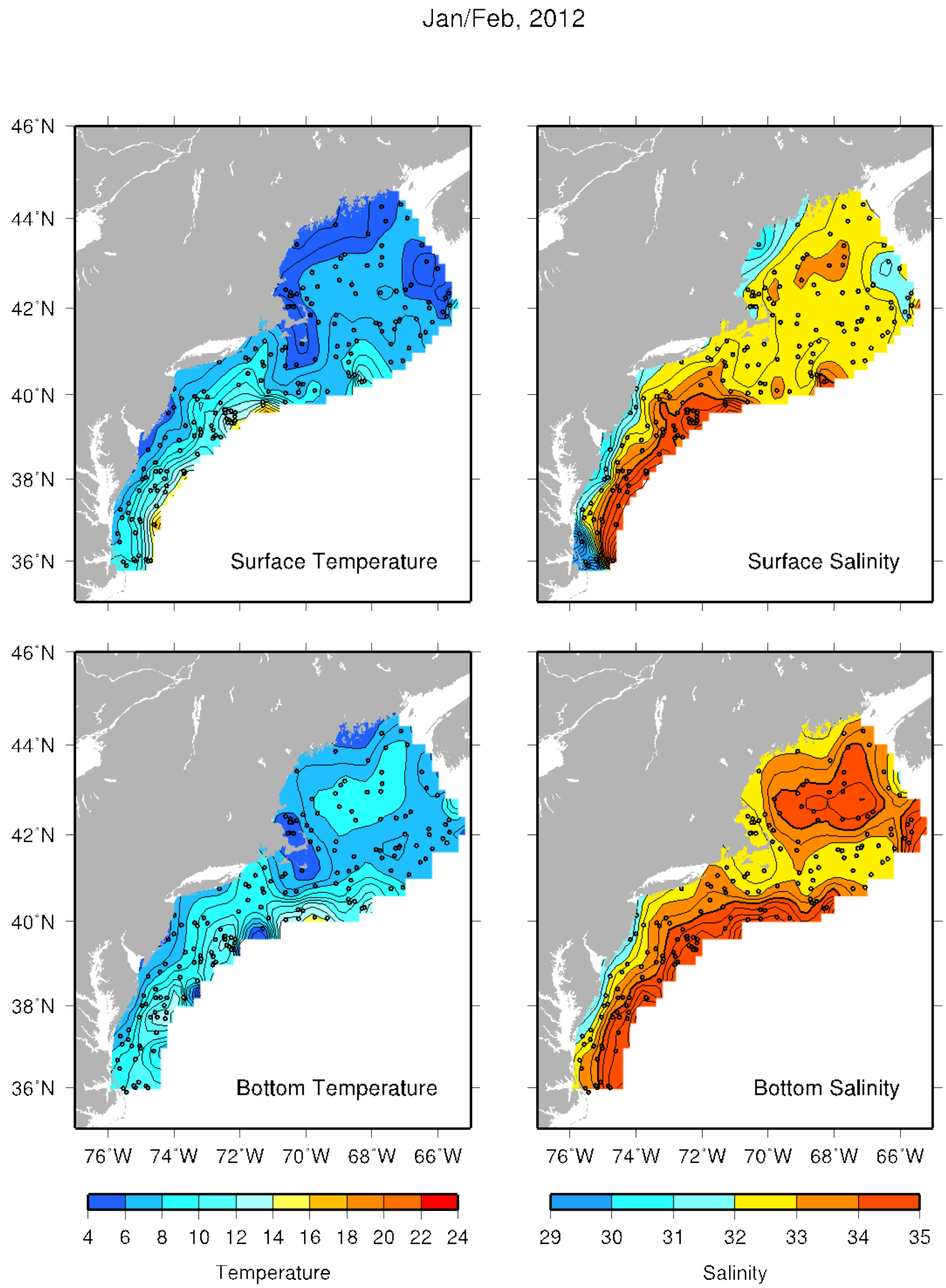

Figure 6a. Near-surface (top) and near-bottom (bottom) temperature (left) and salinity (right) distributions during January-February, 2012. Temperature and salinity are contoured in increments of 1ºC and 0.5, respectively. The 34 isohaline is denoted by the heavier contour.

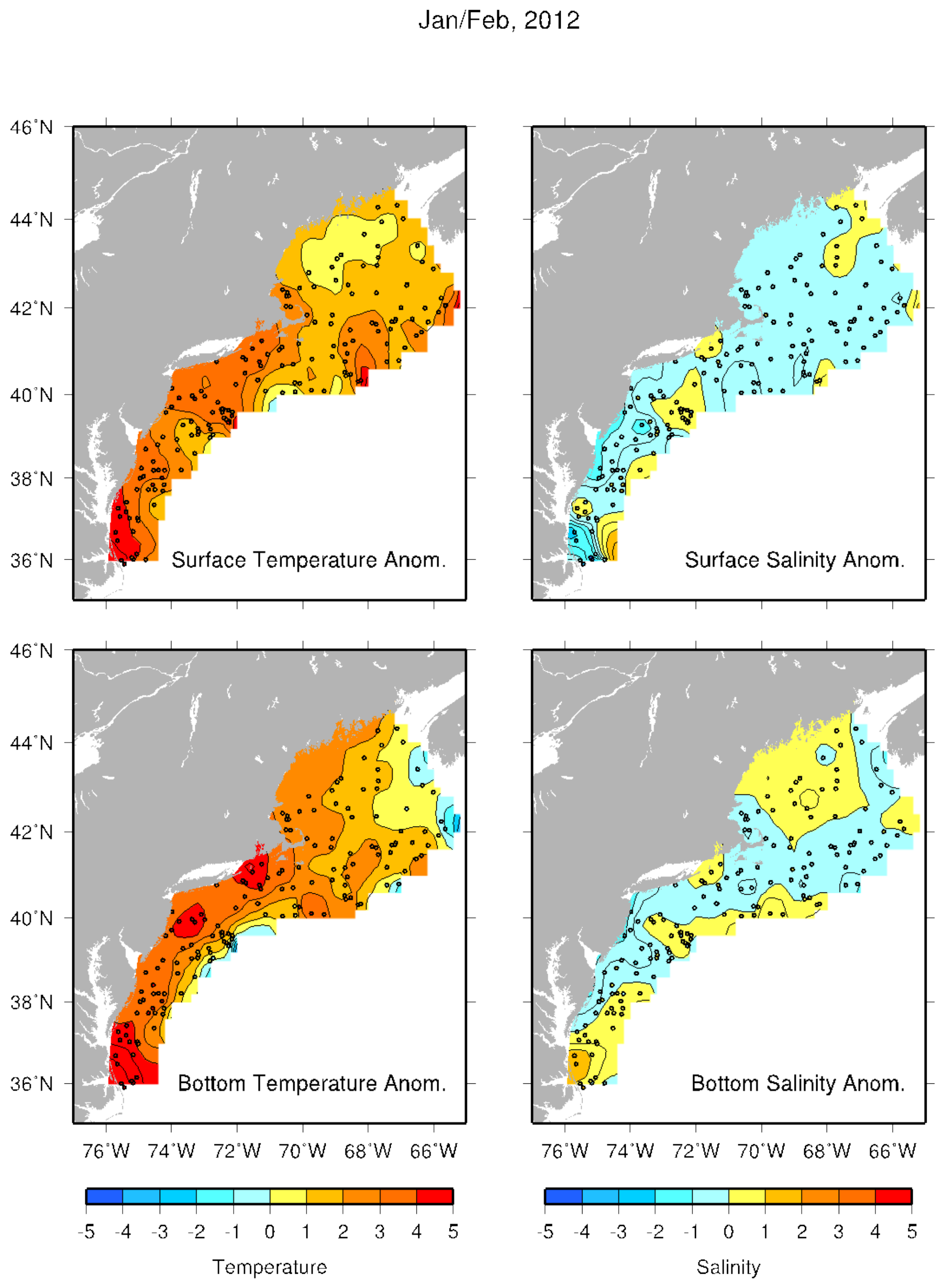

Figure 6b. Near-surface and near-bottom temperature anomaly (left) and salinity anomaly (right) distributions during January-February, 2012. Temperature and salinity anomaly are contoured in increments of 1ºC and 0.5, respectively.

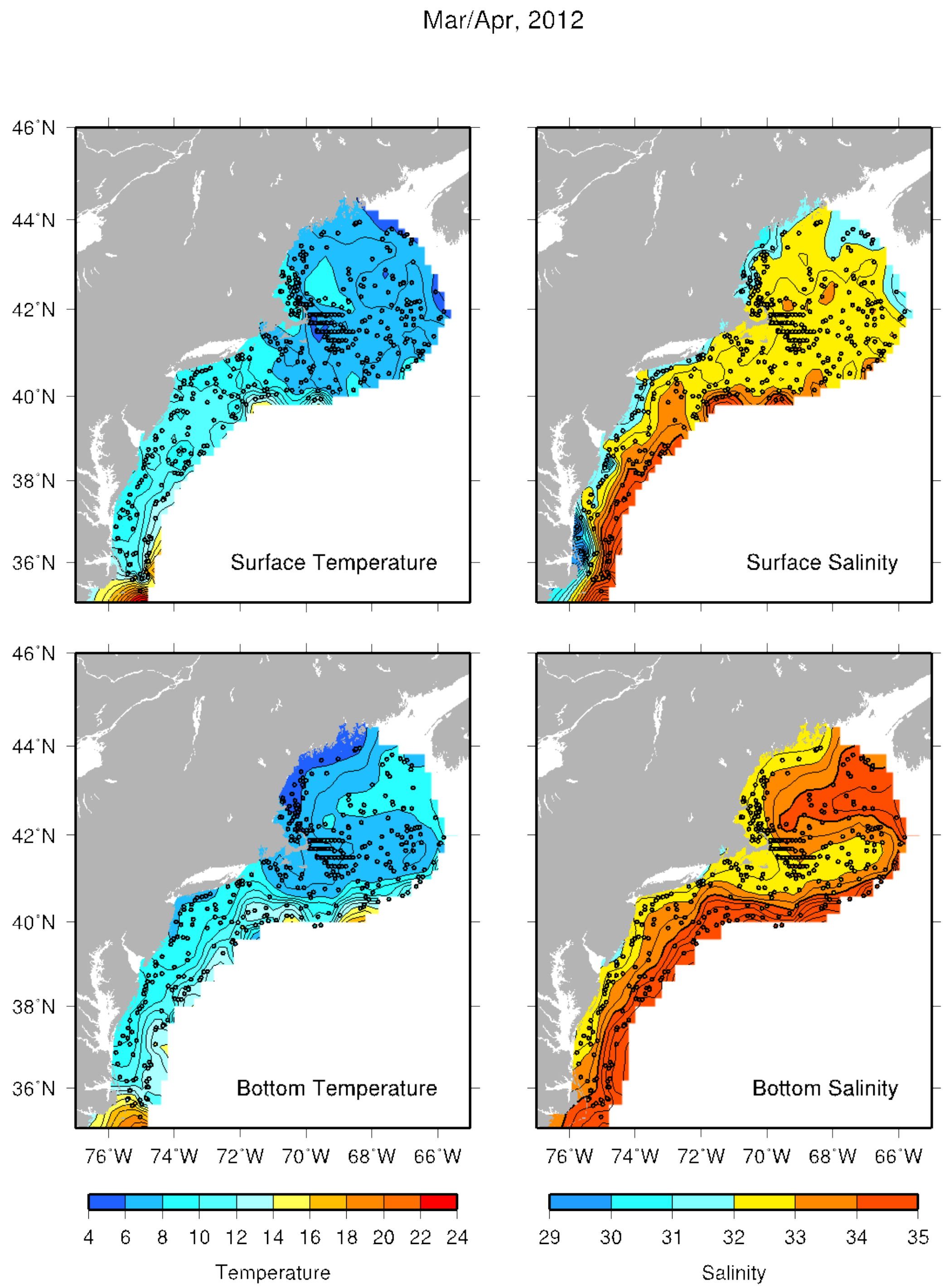

Figure 7a. Near-surface (top) and near-bottom (bottom) temperature (left) and salinity (right) distributions during March-April, 2012. Temperature and salinity are contoured in increments of 1ºC and 0.5, respectively. The 34 isohaline is denoted by the heavier contour.

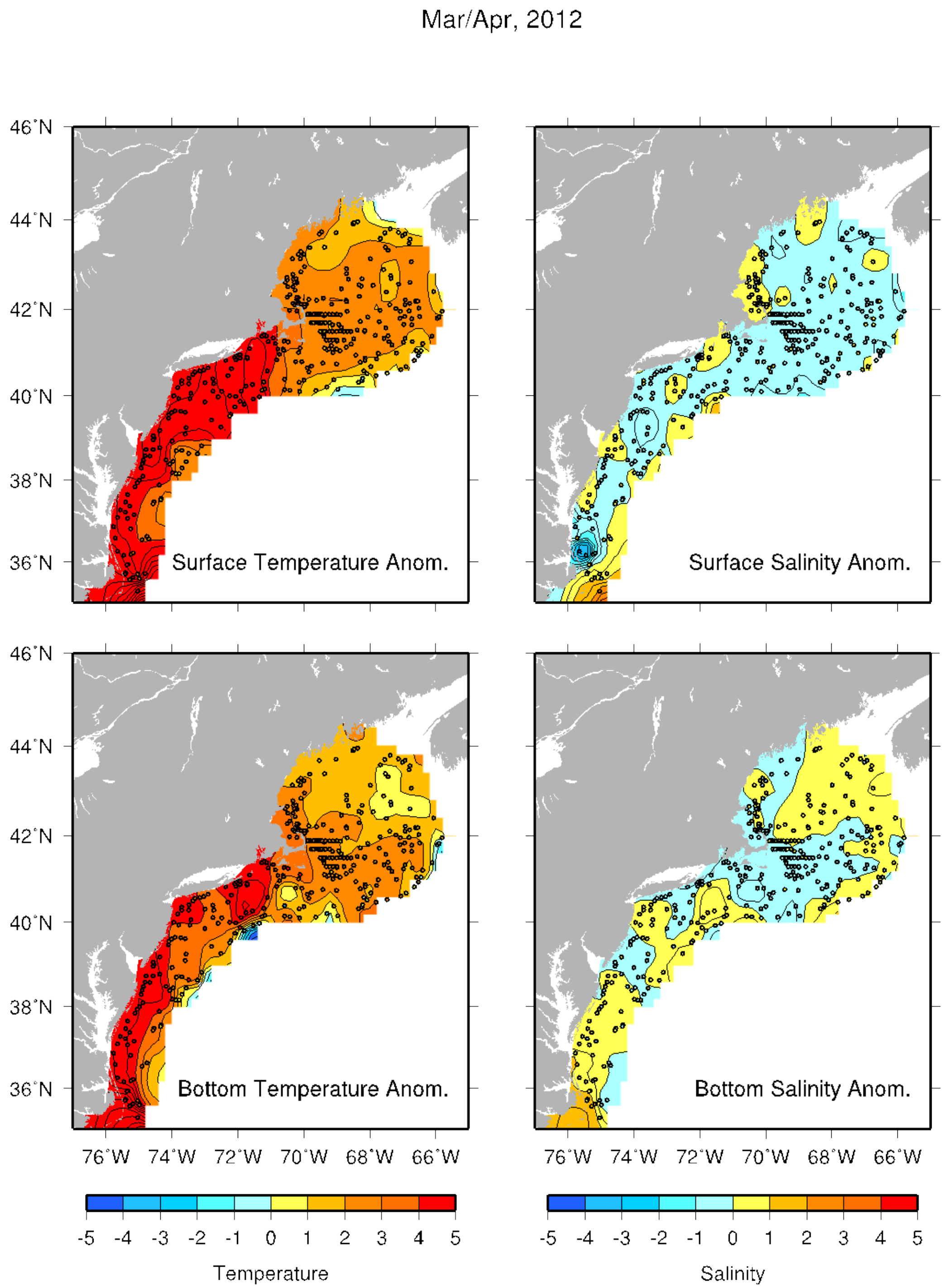

Figure 7b. Near-surface and near-bottom temperature anomaly (left) and salinity anomaly (right) distributions during March-April, 2012. Temperature and salinity anomaly are contoured in increments of 1ºC and 0.5, respectively.

May/Jun, 2012

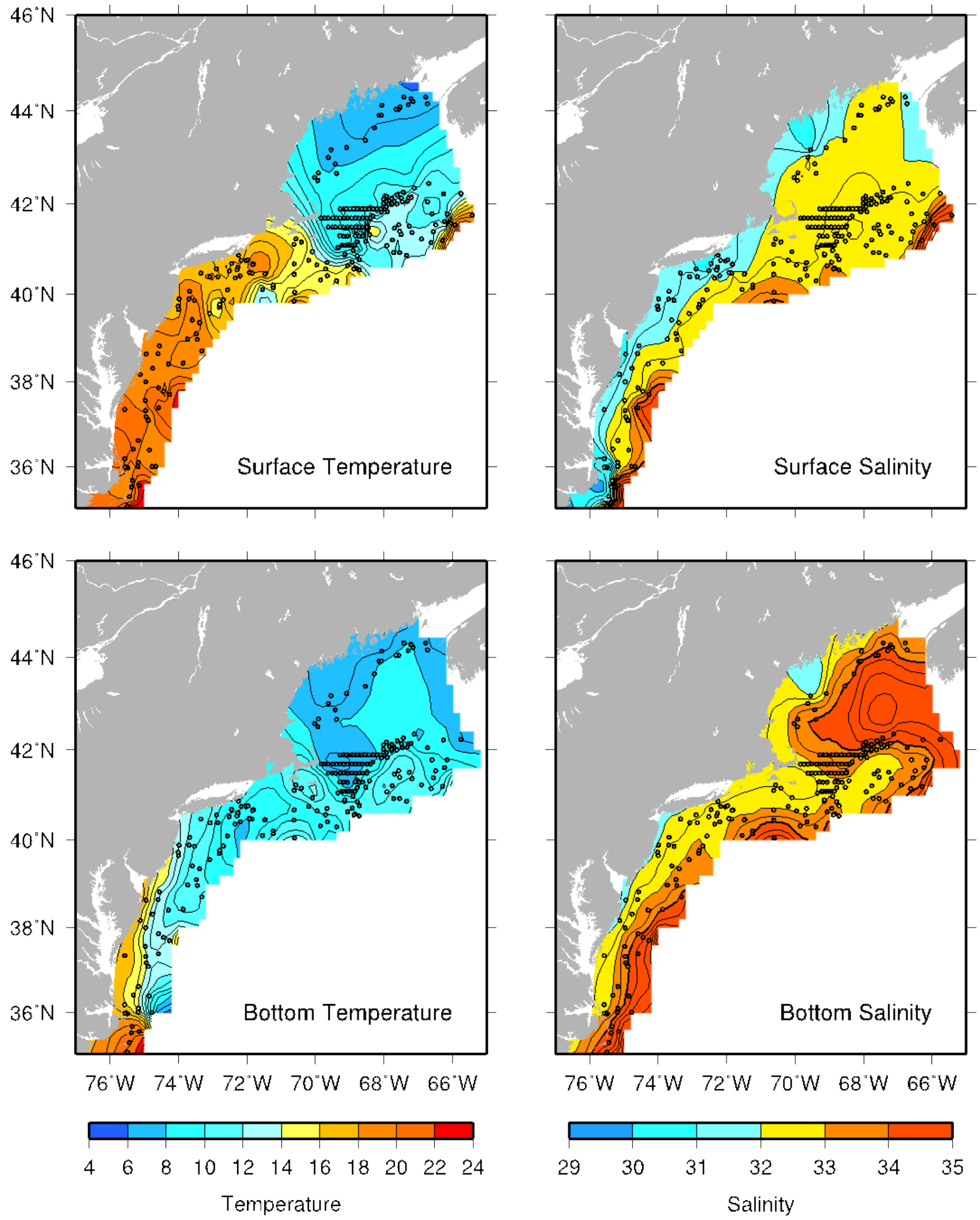

Figure 8a. Near-surface (top) and near-bottom (bottom) temperature (left) and salinity (right) distributions during May-June, 2012. Temperature and salinity are contoured in increments of 1ºC and 0.5, respectively. The 34 isohaline is denoted by the heavier contour.

May/Jun, 2012

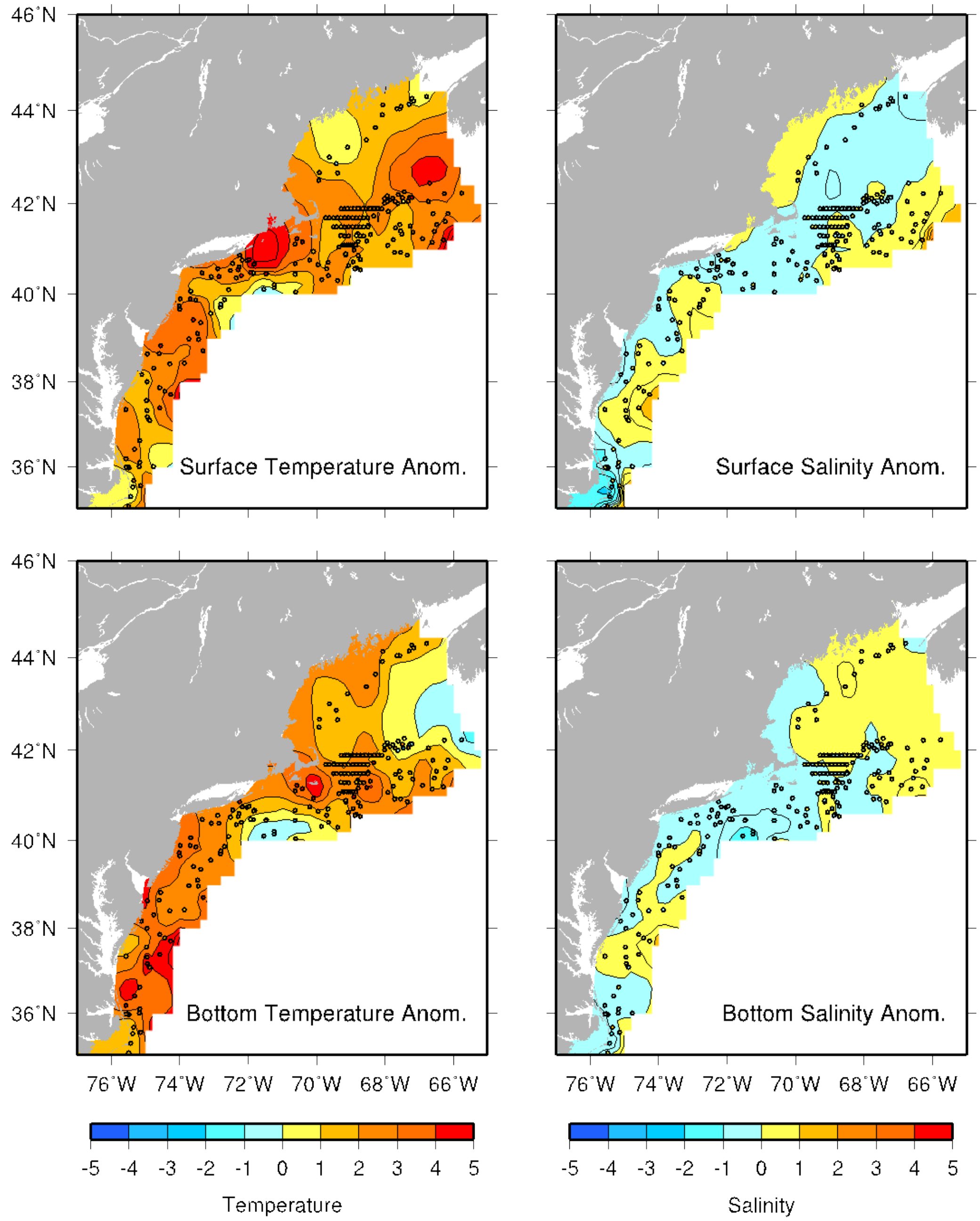

Figure 8b. Near-surface and near-bottom temperature anomaly (left) and salinity anomaly (right) distributions during May-June, 2012. Temperature and salinity anomaly are contoured in increments of 1ºC and 0.5, respectively.

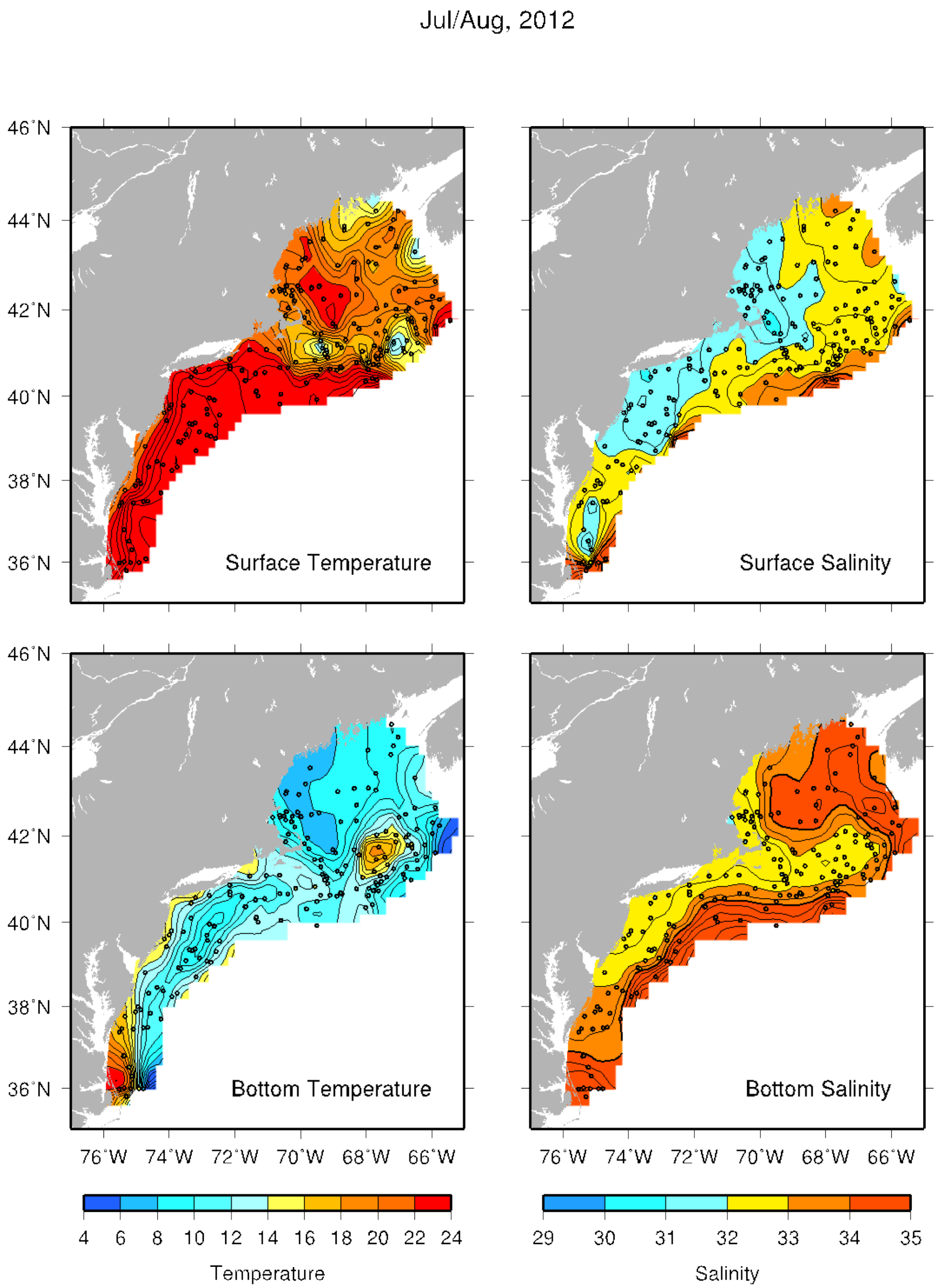

Figure 9a. Near-surface (top) and near-bottom (bottom) temperature (left) and salinity (right) distributions during July-August, 2012. Temperature and salinity are contoured in increments of 1ºC and 0.5, respectively. The 34 isohaline is denoted by the heavier contour.

Jul/Aug, 2012

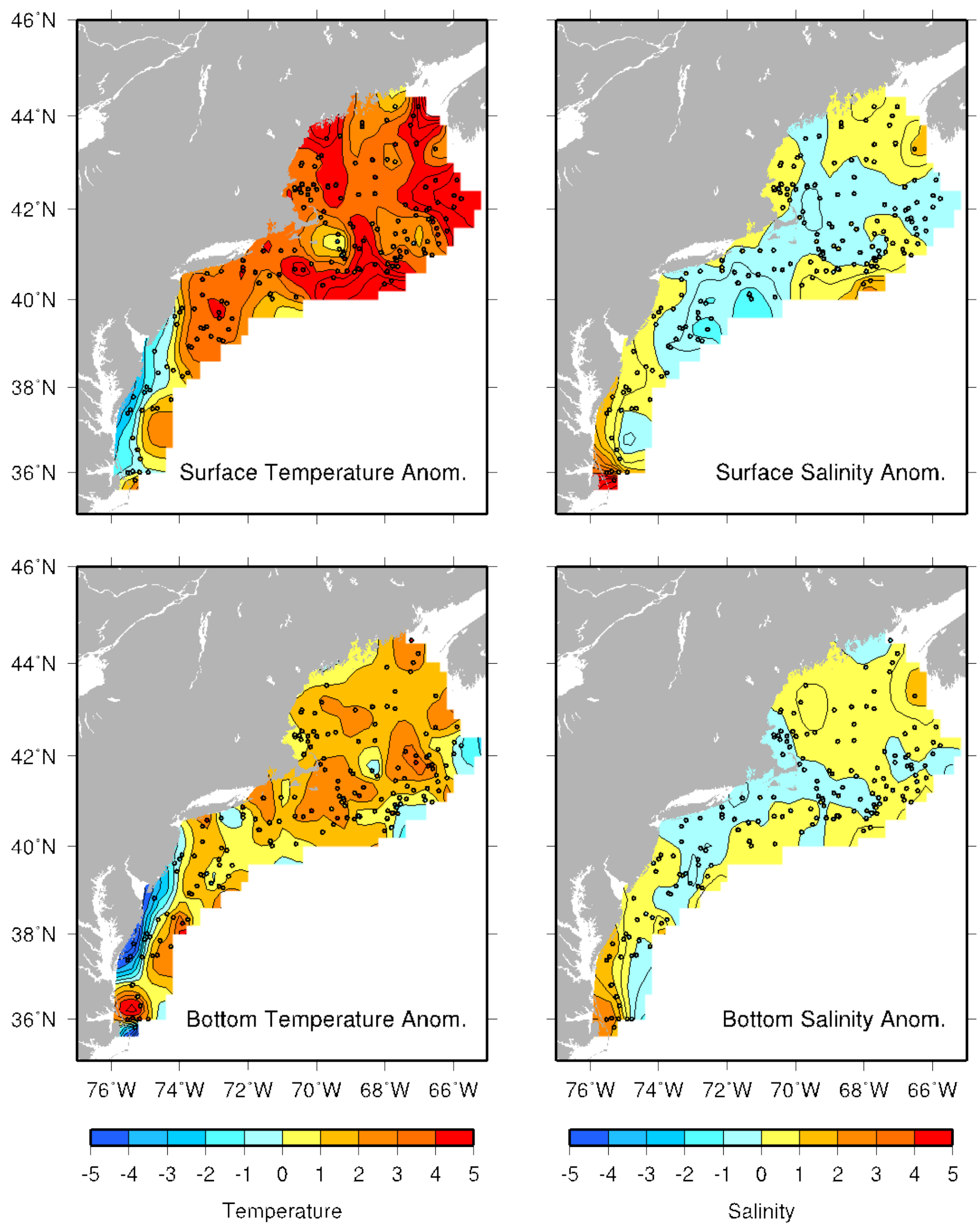

Figure 9b. Near-surface and near-bottom temperature anomaly (left) and salinity anomaly (right) distributions during July-August, 2012. Temperature and salinity anomaly are contoured in increments of 1ºC and 0.5, respectively.

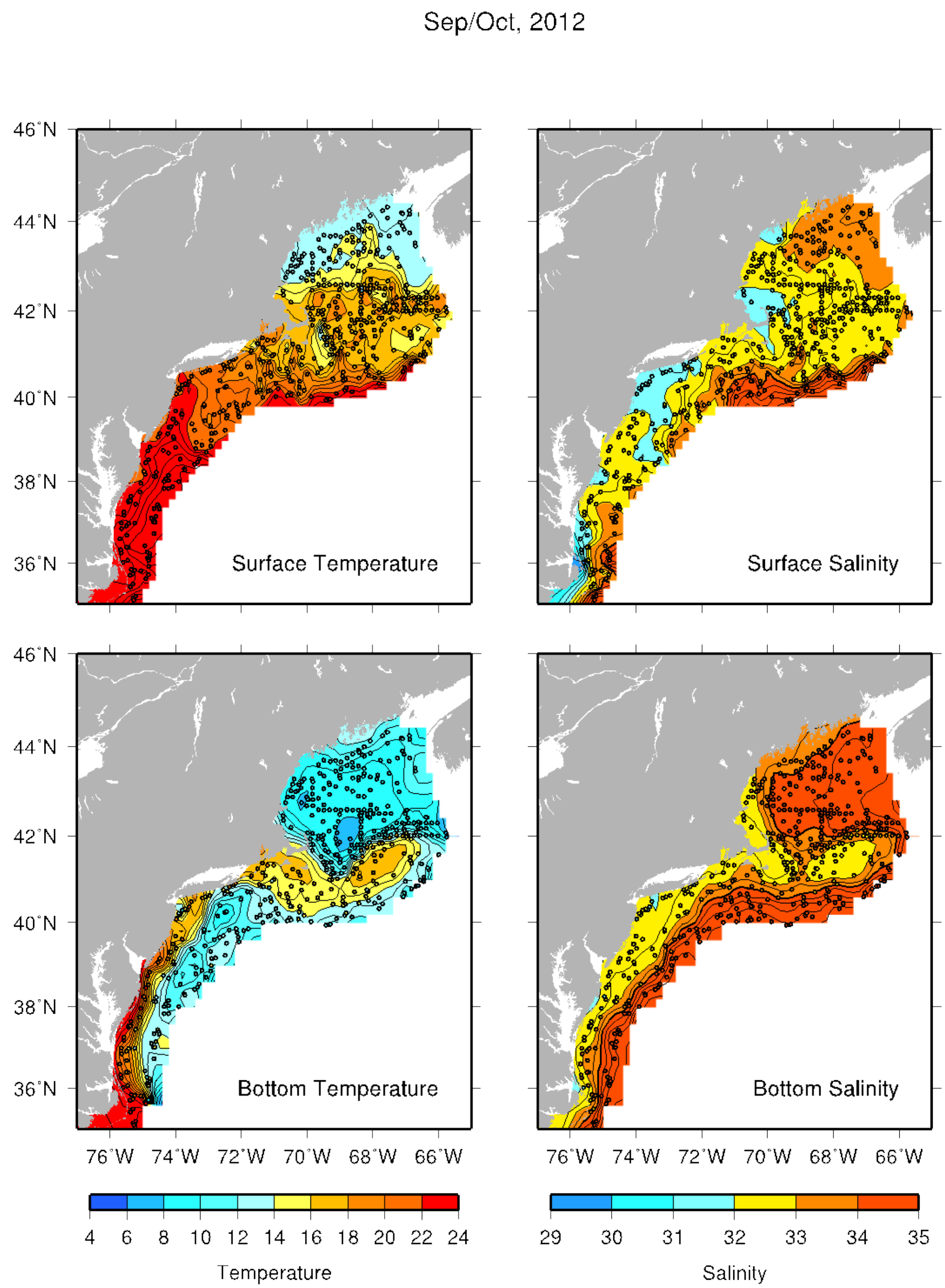

Figure 10a. Near-surface (top) and near-bottom (bottom) temperature (left) and salinity (right) distributions during September-October, 2012. Temperature and salinity are contoured in increments of 1ºC and 0.5, respectively. The 34 isohaline is denoted by the heavier contour.

Sep/Oct, 2012

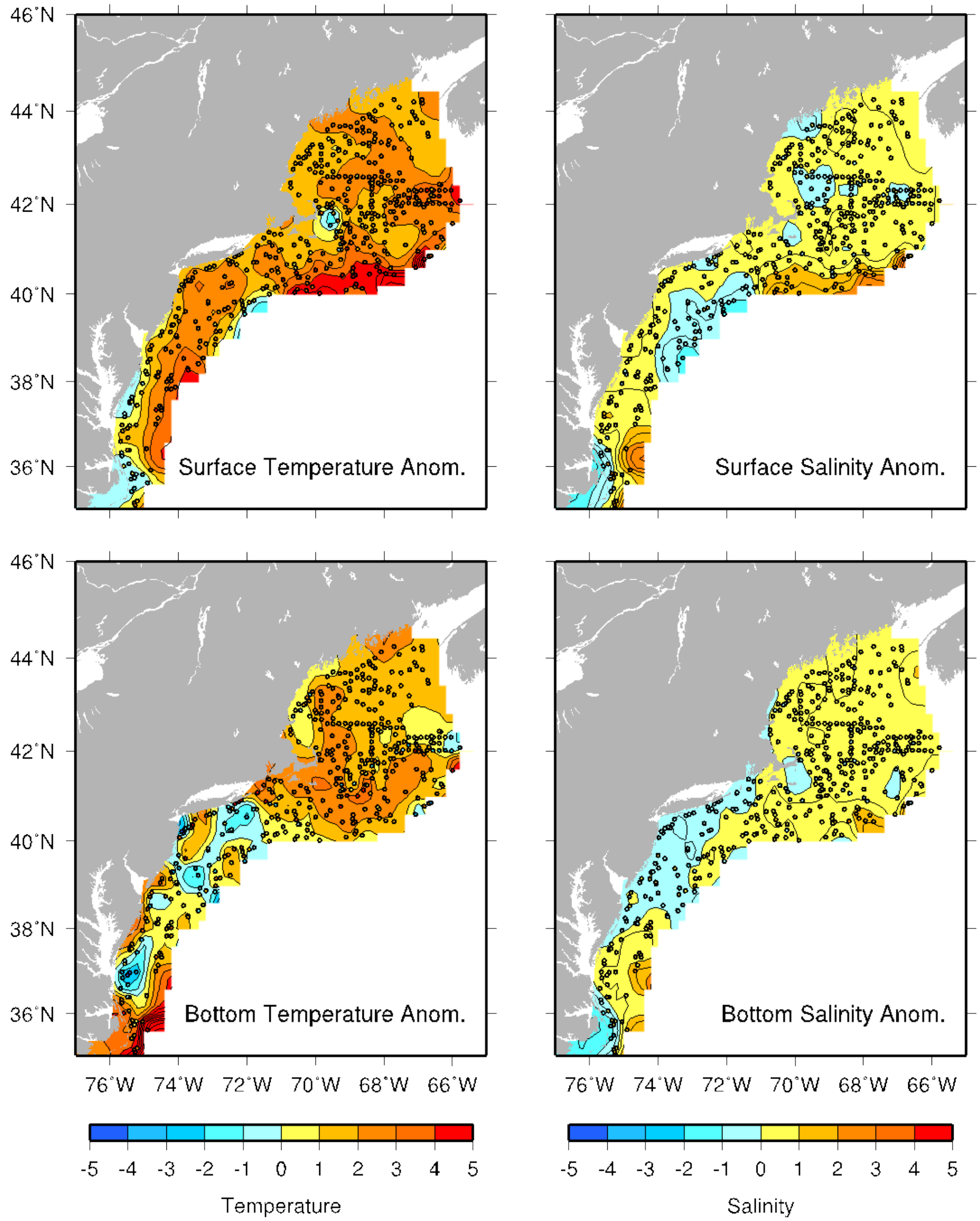

Figure 10b. Near-surface and near-bottom temperature anomaly (left) and salinity anomaly (right) distributions during September-October, 2012. Temperature and salinity anomaly are contoured in increments of 1ºC and 0.5, respectively.

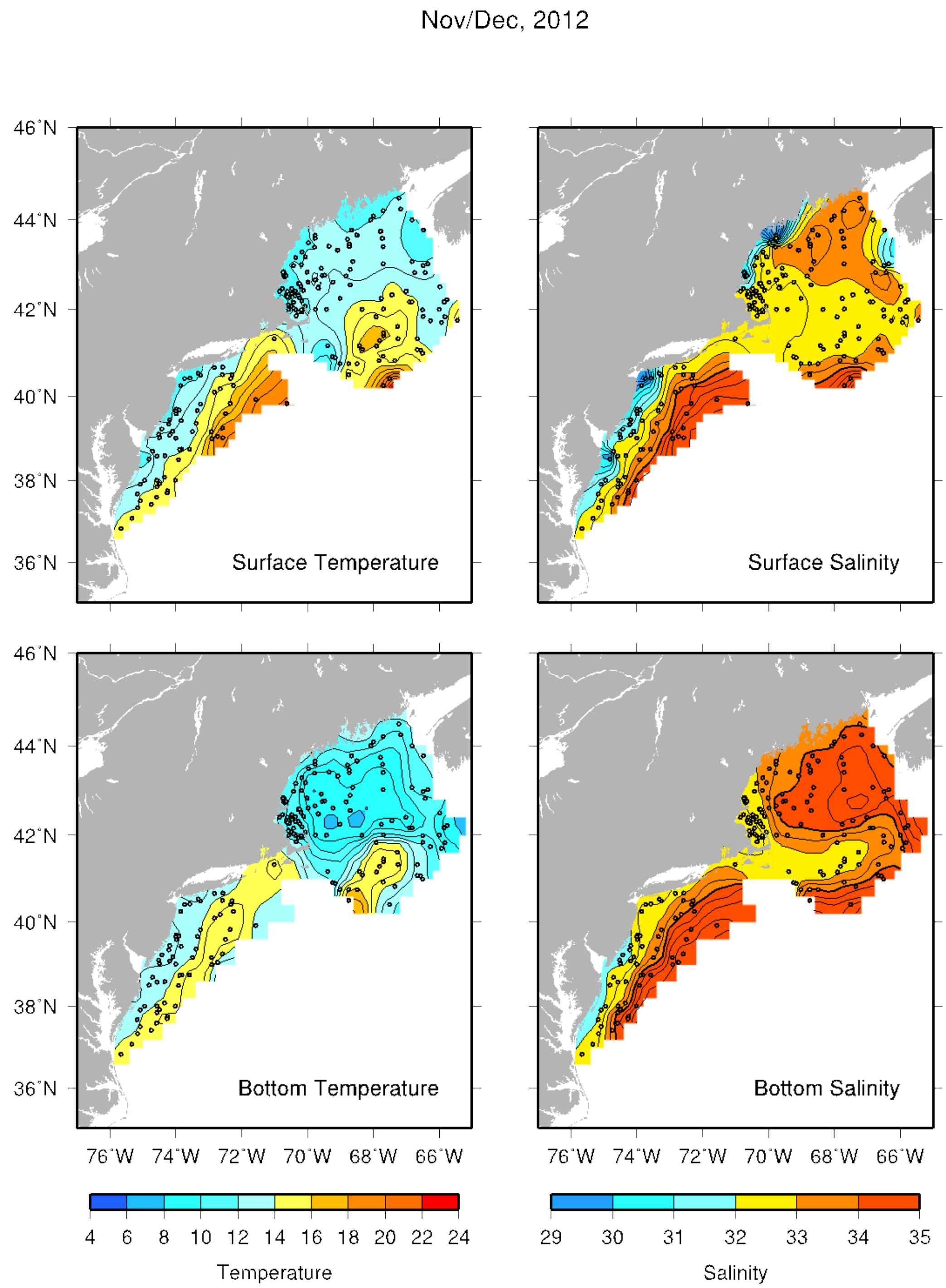

Figure 11a. Near-surface (top) and near-bottom (bottom) temperature (left) and salinity (right) distributions during November-December, 2012. Temperature and salinity are contoured in increments of 1ºC and 0.5, respectively. The 34 isohaline is denoted by the heavier contour.

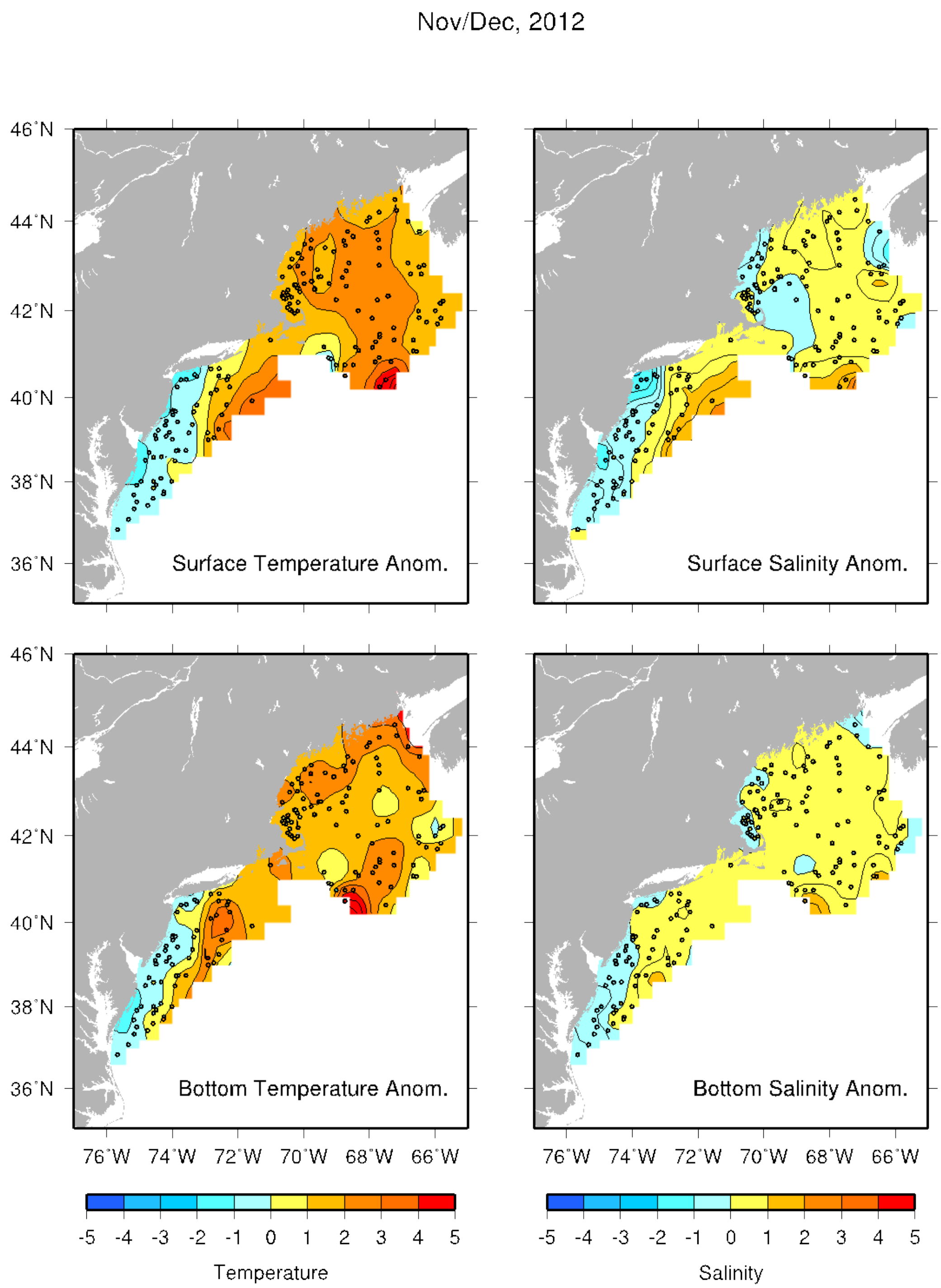

Figure 11b. Near-surface and near-bottom temperature anomaly (left) and salinity anomaly (right) distributions during November-December, 2012. Temperature and salinity anomaly are contoured in increments of 1ºC and 0.5, respectively.

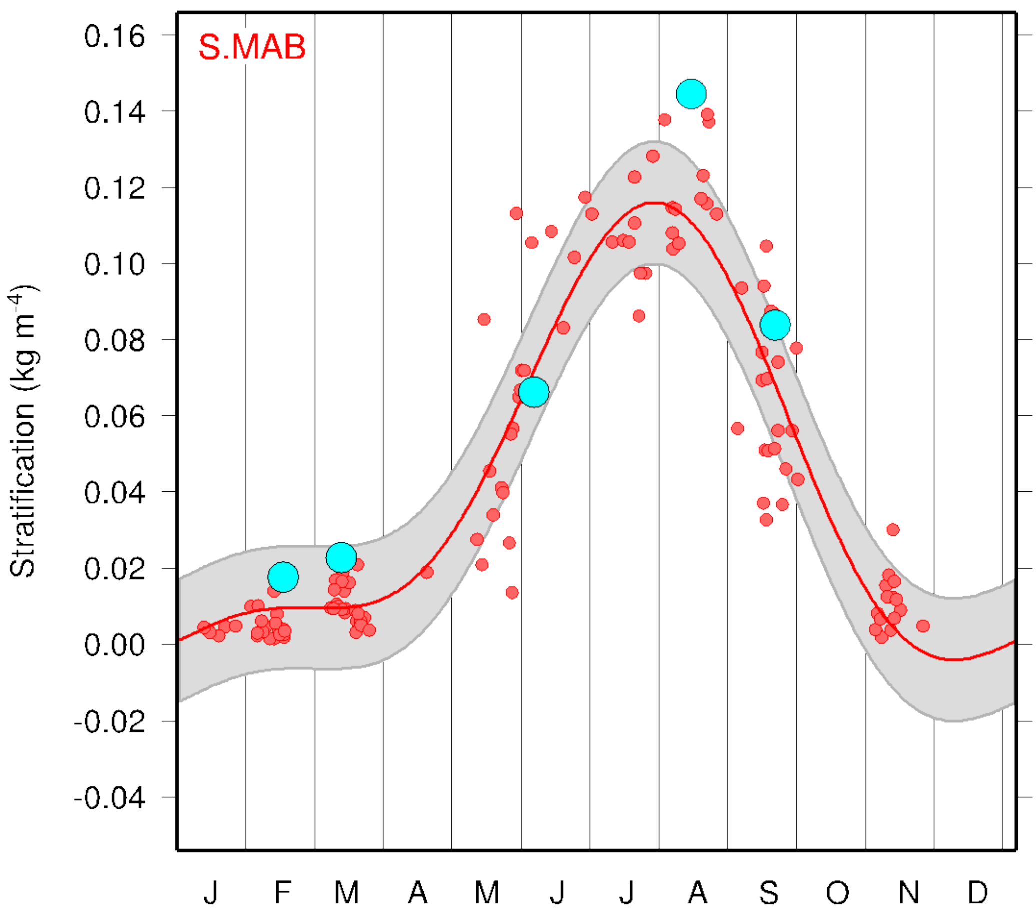

Figure 12. Regional average stratification in the southern Middle Atlantic Bight, defined as the shelf area between Hudson Canyon and Cape Hatteras, as a function of month. Stratification is defined as the density gradient between the surface and 50 meters, or the bottom if the water depth is shallower than 50 meters. The red line is the annual cycle fit to the regional average stratification from each survey occupied between 1981-2010 (red dots). The gray envelope represents one standard deviation. The cyan dots represent the regional average stratification observed in surveys from 2012.

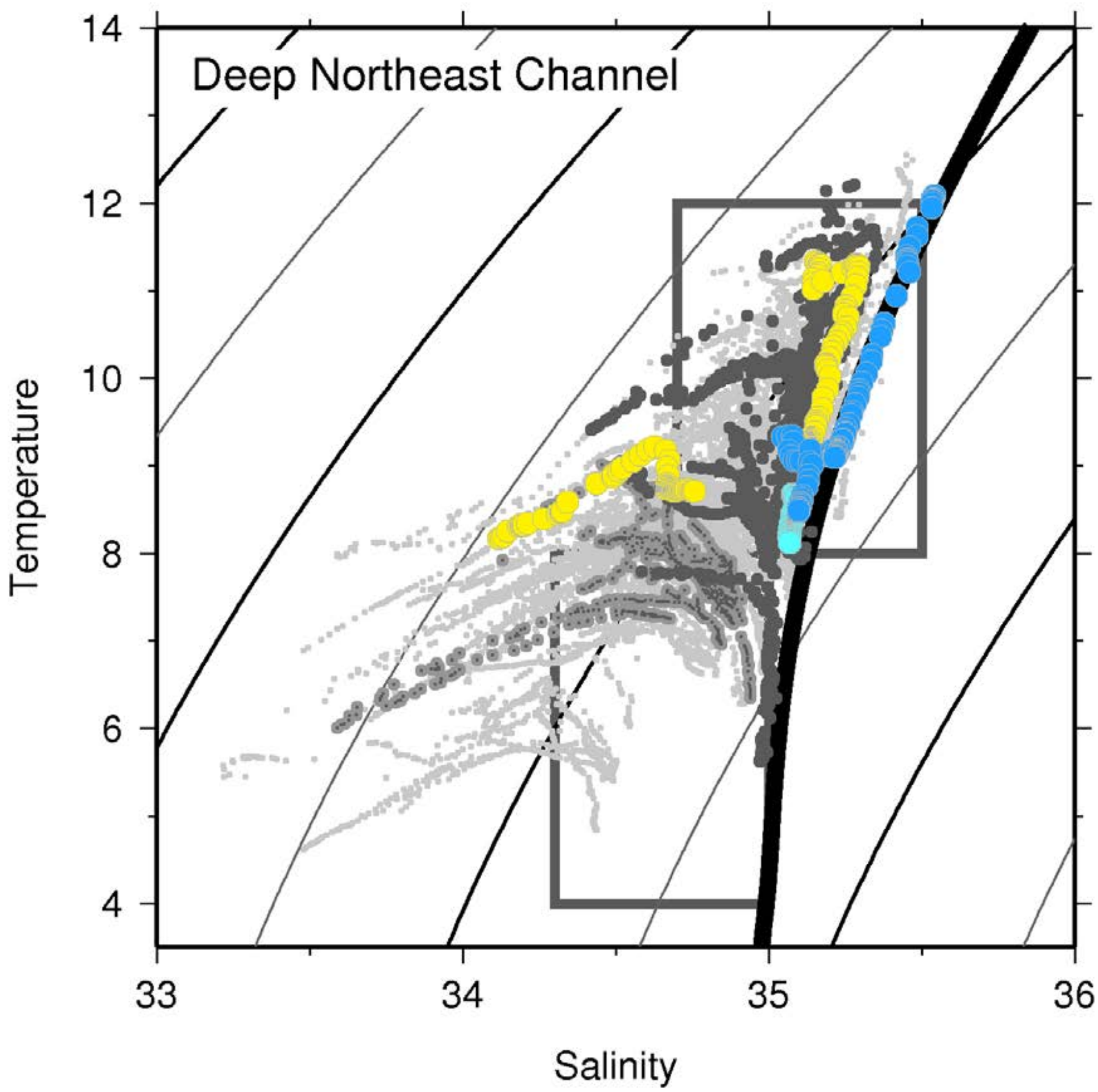

Figure 13. Temperature-salinity from observations deeper than 150 m within the Northeast Channel. Historical observations are shaded by year with lightest grey including all data between 1981-2010, medium grey limited to 2008 and darkest grey to 2011. The colors correspond to individual surveys (months) in 2012 (yellow, cyan and blue were occupied in April, August and October, respectively). The grey boxes denote the typical T-S ranges for the two slope water sources, the cooler/fresher Labrador Slope Water and warmer/saltier Warm Slope Water. The heavy black curve represents the standard curve for North Atlantic Central Water (representing Gulf Stream water).

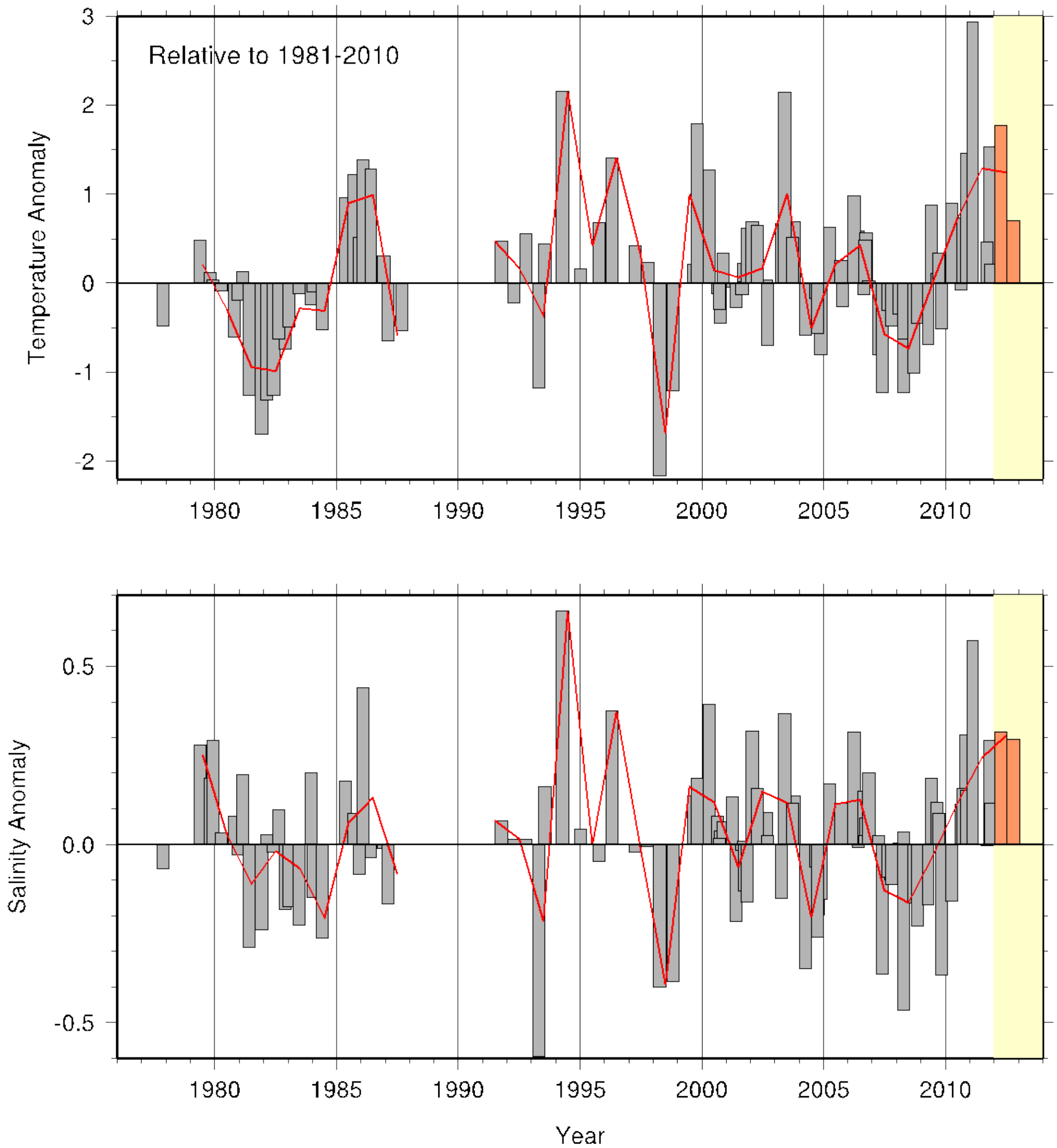

Figure 14. Time series of the regional volume-weighted average temperature (top) and salinity (bottom) anomaly between 150-200 m in the Northeast Channel. Anomalies are calculated relative to the annual cycle for the period 1981-2010. Annual average anomalies are shown by the red curve. Bars representing 2012 anomalies are colored orange. Positive anomalies correspond to warm/salty conditions.

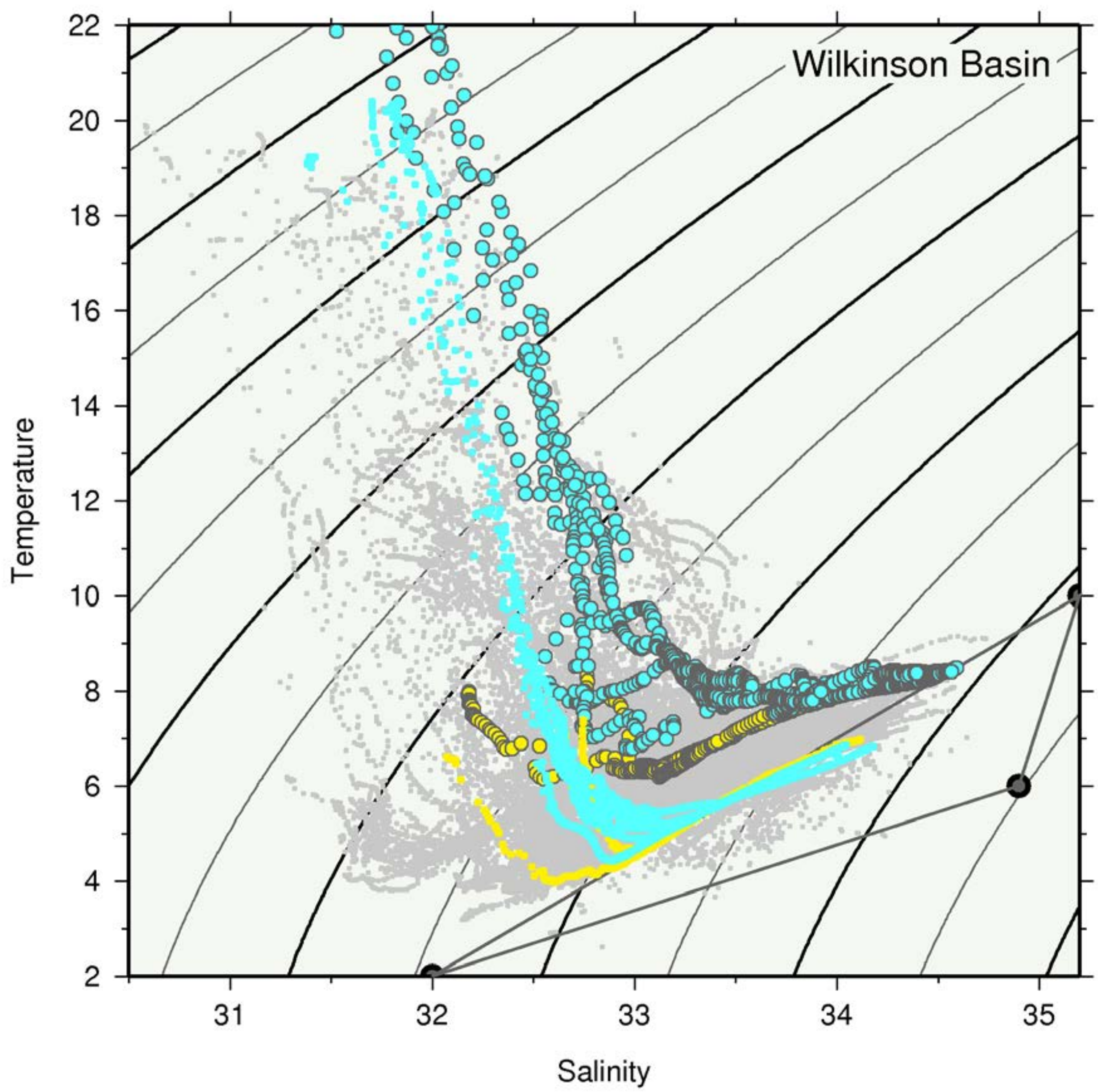

Figure 15. Temperature-salinity from observations in Wilkinson Basin, which is the western-most deep basin in the Gulf of Maine. Historical observations collected between 1981-2010 are shown in grey. Cyan dots without outline were collected in August 2008 while those with grey outline were occupied in August 2012. Similarly, the yellow dots were occupied in May 2008 and 2012. The T-S properties of the three dominant sources to the Gulf of Maine are shown by the mixing triangle, representing cold/fresh Scotian Shelf Water, warmer/saltier Labrador Slope Water and warmest/saltiest Warm Slope Water. The temperature minimum characterizing Cold Intermediate Water is located at the elbow in the T-S curves.

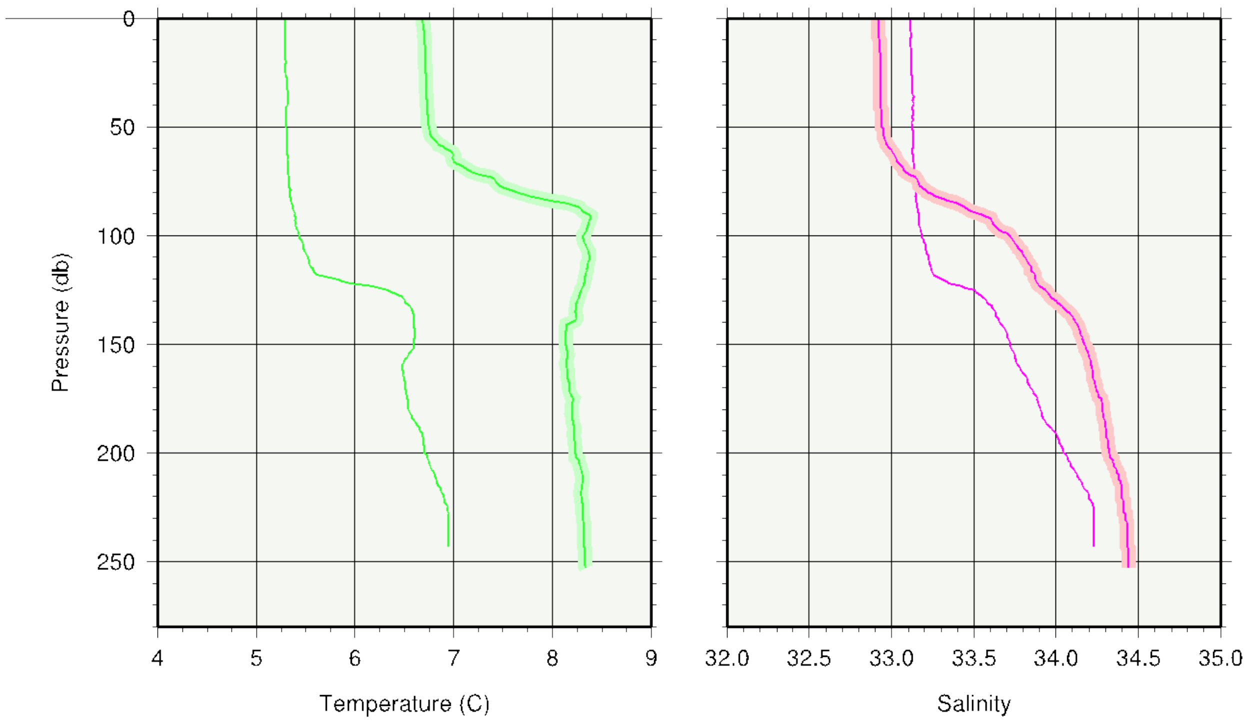

Figure 16. Profiles of temperature (left) and salinity (right) collected in February at a standard station in Wilkinson Basin (the westernmost deep basin in the Gulf of Maine). Thicker lines show the average 2012 profile while thinner lines are derived from stations occupied in 2008. The winter mixed layer is characterized by the homogenization of properties extending from the surface to varying depths. The lower limit of these mixed layers, where profiles of temperature and salinity change abruptly from uniformly low to higher values, corresponds with the depth to which vertical mixing penetrates during a given winter.

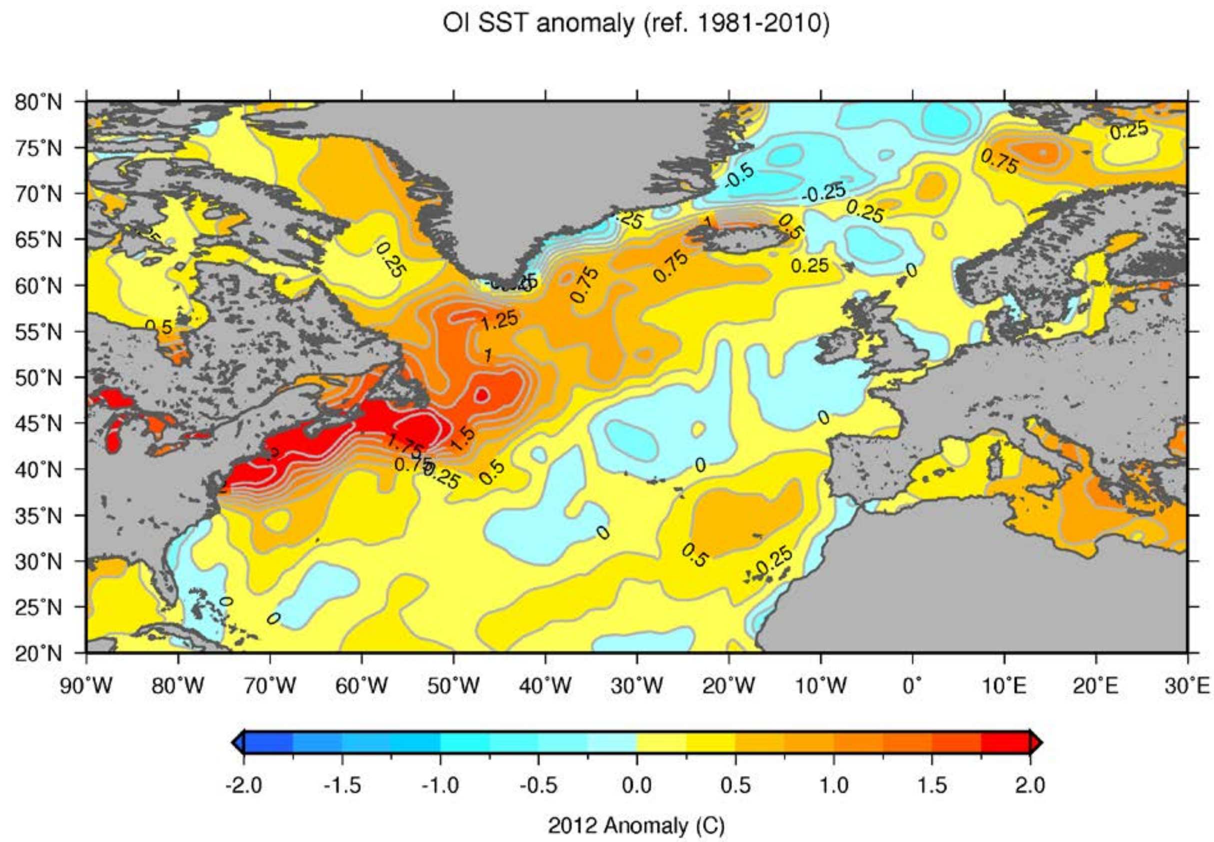

Figure 17. Sea surface temperature (SST) anomaly derived from NOAA's Optimum Interpolation (OI) SST product (http://www.esrl.noaa.gov/psd/data/gridded/data.noaa.oisst.v2.html). Positive anomalies correspond to warming in 2012 relative to the reference period (1981-2010).

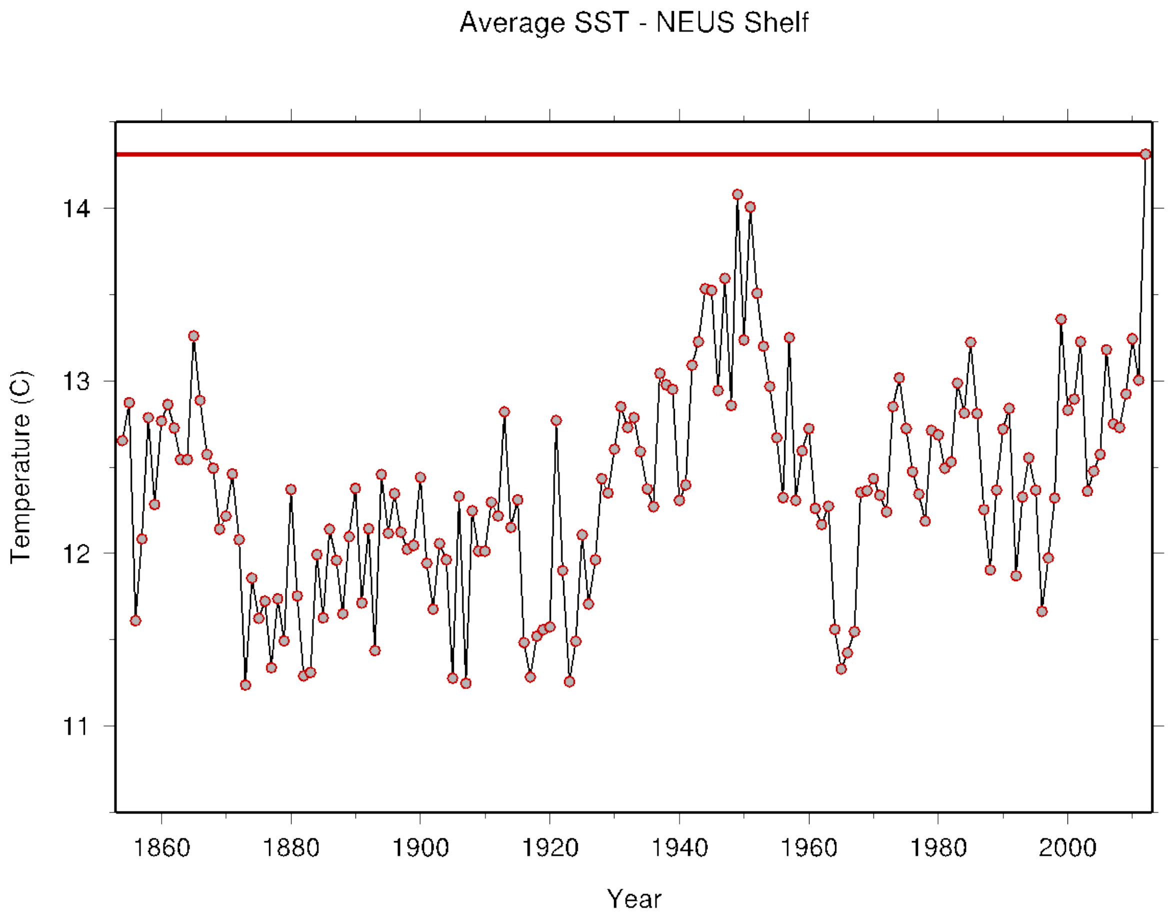

Figure 18. Regional average sea surface temperature for the NEUS shelf region calculated from NOAA's extended reconstructed sea surface temperature product (http://www.esrl.noaa.gov/psd/data/gridded/data.noaa.ersst.html). The horizontal red line marks the magnitude of the average SST during 2012.

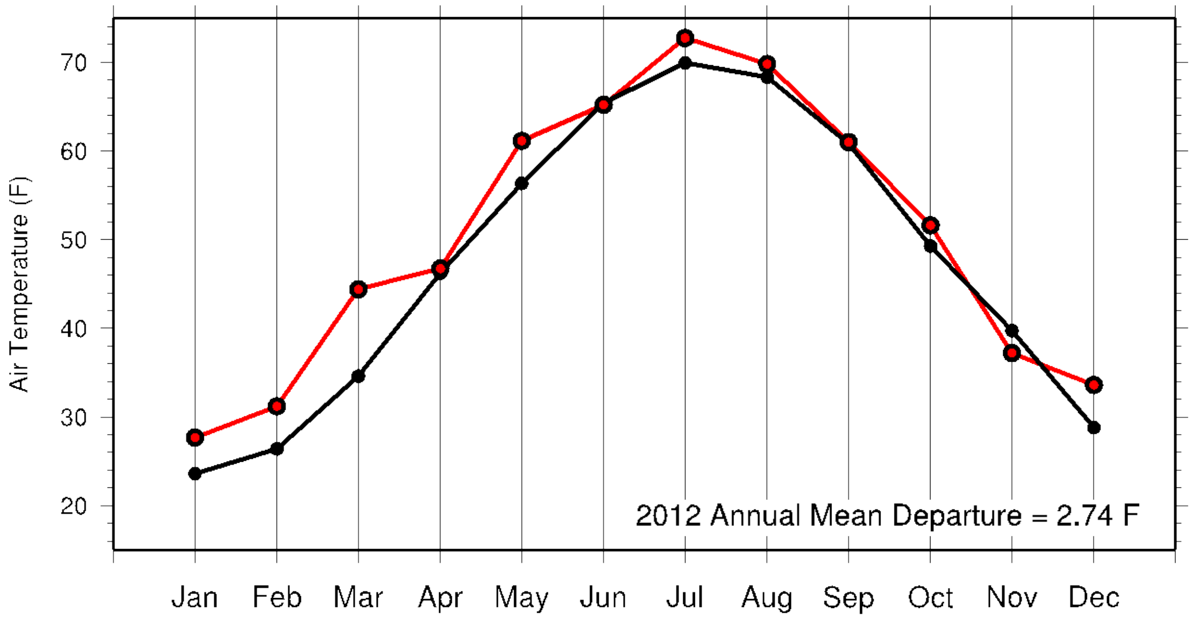

Figure 19. Monthly mean air temperature over the Northeastern U.S. for the years 1971-2000 (black) and 2012 (red), plotted from climate summary data compiled by the Northeast Regional Climate Center (http://www.nrcc.cornell.edu). The northeast region encompasses coastal states from Maine to Maryland and inland states west to West Virginia.

Table A1. 2012 regional average temperature and salinity values for individual cruises that sampled within the eastern Gulf of Maine (boundaries defined in Figure 1.) Average values incorporating less than 10 observations are shown in gray.

Gulf of Maine East

Cruise	CD	#obs	Surface Temp	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Temp	Anomaly	SDV1	SDV2	Flag
DEL1202	41	55	6.15	1.5	0.22	1.56	1	49	7.6	2.14	0.2	1.41	1
DEL1203	80	53	6.71	2.88	0.16	0.80	1	53	6.80	2.74	0.13	0.69	1
HB1201	113	58	7.40	1.96	0.14	0.71	0	57	7.16	2.00	0.12	0.62	0
DEL1205	130	48	9.38	2.21	0.15	0.71	1	47	7.27	2.06	0.13	0.53	1
HB1202	165	3	14.60	3.94	0.73	5.87	1	3	6.22	0.41	0.75	4.73	1
S11201	182	9	17.59	3.42	0.38	3.37	1	9	7.92	2.43	0.33	3.89	1
HB1205	234	42	20.58	3.67	0.19	1.46	0	28	8.20	1.47	0.20	3.09	1
PC1206	277	104	15.68	2.00	0.11	1.05	0	105	8.72	1.67	0.09	1.16	0
HB1206	299	51	13.78	2.15	0.15	0.73	0	50	9.22	1.88	0.13	1.01	0
PC1207	308	16	12.97	2.07	0.23	0.85	0	14	9.44	1.73	0.21	1.03	0

Cruise	CD	#obs	Surface Salinity	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Salinity	Anomaly	SDV1	SDV2	Flag
DEL1202	41	55	32.64	-0.21	0.14	0.47	1	49	33.62	0.02	0.12	0.52	1
DEL1203	80	53	32.63	-0.19	0.10	0.36	1	53	33.22	0.06	0.08	0.23	1
HB1201	113	58	32.38	-0.12	0.09	0.38	0	57	33.43	0.11	0.07	0.27	0
DEL1205	130	48	32.65	-0.20	0.09	0.27	1	47	33.62	0.17	0.08	0.34	1
HB1202	165	3	31.96	-0.33	0.36	2.19	1	3	32.78	-0.05	0.33	1.15	1
S11201	182	9	31.58	-0.33	0.23	0.89	1	9	32.54	-0.23	0.19	0.54	1
HB1205	234	42	31.91	-0.05	0.12	0.32	0	28	33.30	0.20	0.11	0.67	1
PC1206	277	104	32.60	0.23	0.07	0.38	0	105	34.00	0.36	0.05	0.28	0
HB1206	299	51	32.81	0.23	0.10	0.33	0	50	33.92	0.30	0.08	0.29	0
PC1207	308	16	32.41	0.18	0.16	0.25	0	14	33.80	0.30	0.13	0.21	0

"Cruise", the code name for a cruise:
CD, the calendar mid-date of all the stations within a region for that cruise:
"#obs", the number of observations included in each average:
"Temp", the areal average temperature: "Salt", the areal average salinity:
Anomaly, the areal average temperature or salinity anomaly:
"SDV1",the standard deviation associated with the average temperature or salinity anomaly:
"SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived:
Flag, a value of "1" indicates that a true areal average could not be calculated due to poor station coverage.
The areal averages listed were derived from a simple average of the observations within the region.

Table A2. 2012 regional average temperature and salinity values for individual cruises that sampled within the western Gulf of Maine (boundaries defined in Figure 1.) Average values incorporating less than 10 observations are shown in gray.

Gulf of Maine West

Cruise	CD	#obs	Surface Temp	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Temp	Anomaly	SDV1	SDV2	Flag
DEL1202	40	12	5.98	1.28	0.25	0.9	0	10	7.61	0.5	0.27	1.13	0
HB1201	107	33	6.64	1.70	0.17	0.74	0	28	8.14	1.13	0.19	0.84	0
DEL1205	140	15	11.17	3.41	0.27	1.72	1	13	7.89	0.78	0.27	1.49	1
S11201	176	3	13.83	2.91	0.55	9.21	1	3	9.33	-1.03	0.54	10.43	1
HB1205	233	17	18.61	4.59	0.21	1.79	0	10	10.40	1.92	0.27	1.69	0
PC1206	259	22	18.70	3.19	0.22	2.79	1	22	8.82	0.16	0.20	3.21	1
HB1206	295	30	14.16	1.93	0.18	0.54	0	29	9.72	1.43	0.19	0.93	0
PC1207	311	21	12.74	1.85	0.21	0.60	0	15	10.29	1.71	0.24	1.25	0

Cruise	CD	#obs	Surface Salinity	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Salinity	Anomaly	SDV1	SDV2	Flag
DEL1202	40	12	32.58	-0.08	0.18	0.34	0	10	33.89	-0.13	0.15	0.32	0
HB1201	107	33	32.21	-0.30	0.12	0.30	0	28	34.25	0.20	0.09	0.34	0
DEL1205	140	15	32.58	-0.06	0.17	0.60	1	13	34.18	0.13	0.16	0.90	1
S11201	176	3	32.41	-0.25	0.32	2.37	1	3	32.82	0.17	0.32	1.47	1
HB1205	233	17	32.61	0.22	0.17	0.41	0	10	34.35	0.42	0.17	0.50	0
PC1206	259	22	32.36	-0.05	0.14	0.98	1	22	34.66	0.19	0.11	0.74	1
HB1206	295	30	33.15	0.46	0.12	0.30	0	29	34.73	0.29	0.10	0.24	0
PC1207	311	21	32.83	0.22	0.16	0.48	0	15	34.39	0.26	0.14	0.33	0

"Cruise", the code name for a cruise:
CD, the calendar mid-date of all the stations within a region for that cruise:
"#obs", the number of observations included in each average:
"Temp", the areal average temperature: "Salt", the areal average salinity:
Anomaly, the areal average temperature or salinity anomaly:
"SDV1",the standard deviation associated with the average temperature or salinity anomaly:
"SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived:
Flag, a value of "1" indicates that a true areal average could not be calculated due to poor station coverage.
The areal averages listed were derived from a simple average of the observations within the region.

Table A3. 2012 regional average temperature and salinity values for individual cruises that sampled within the Georges Bank area (boundaries defined in Figure 1.) Average values incorporating less than 10 observations are shown in gray.

Georges Bank

Cruise	CD	#obs	Surface Temp	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Temp	Anomaly	SDV1	SDV2	Flag
DEL1202	37	31	7.53	2.08	0.2	1.12	0	27	7.98	1.69	0.24	1.11	0
DEL1203	81	9	7.10	2.41	0.39	0.50	1	7	7.00	2.31	0.41	0.46	1
HB1201	101	57	7.22	1.90	0.15	0.79	0	44	7.11	1.84	0.18	0.93	0
DEL1205	127	16	8.94	2.62	0.28	0.90	1	15	7.41	2.20	0.28	0.57	1
HB1202	164	36	12.56	2.11	0.19	1.30	0	32	10.45	2.10	0.20	1.15	0
S11201	182	25	14.44	2.52	0.21	1.60	1	25	10.49	1.61	0.21	2.00	1
HB1205	229	56	20.16	3.93	0.14	2.35	1	49	13.29	1.31	0.15	2.17	1
PC1206	260	20	18.23	2.78	0.21	1.49	1	20	14.71	1.47	0.21	2.68	1
HB1206	287	58	17.71	2.89	0.14	1.65	0	40	14.66	2.29	0.18	1.29	0
PC1207	310	25	14.99	2.11	0.20	1.26	0	23	13.87	1.97	0.23	1.43	0
Cruise	**CD**	**#obs**	**Surface Salinity**	**Anomaly**	**SDV1**	**SDV2**	**Flag**	**#obs**	**Bottom Salinity**	**Anomaly**	**SDV1**	**SDV2**	**Flag**
DEL1202	37	31	32.69	-0.25	0.13	0.37	0	27	32.88	-0.31	0.14	0.32	0
DEL1203	81	9	32.89	-0.18	0.22	0.20	1	7	33.02	-0.09	0.22	0.32	1
HB1201	101	56	32.79	-0.22	0.09	0.30	0	43	32.91	-0.24	0.11	0.33	0
DEL1205	127	16	32.73	-0.16	0.16	0.16	1	15	33.03	-0.04	0.15	0.10	1
HB1202	164	36	32.87	0.09	0.11	0.48	0	32	32.99	0.02	0.12	0.28	0
S11201	182	25	32.66	0.04	0.12	0.42	1	25	32.98	0.11	0.12	0.27	1
HB1205	229	56	32.57	-0.14	0.08	0.71	1	49	32.82	-0.07	0.09	0.45	1
PC1206	260	20	32.61	0.09	0.12	0.46	1	20	32.86	0.16	0.12	0.33	1
HB1206	287	58	33.21	0.45	0.08	0.74	0	40	33.49	0.37	0.11	0.50	0
PC1207	310	25	33.04	0.32	0.12	0.48	0	23	33.33	0.38	0.13	0.41	0

"Cruise", the code name for a cruise:
CD, the calendar mid-date of all the stations within a region for that cruise:
"#obs", the number of observations included in each average:
"Temp", the areal average temperature: "Salt", the areal average salinity:
Anomaly, the areal average temperature or salinity anomaly:
"SDV1",the standard deviation associated with the average temperature or salinity anomaly:
"SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived:
Flag, a value of "1" indicates that a true areal average could not be calculated due to poor station coverage.
The areal averages listed were derived from a simple average of the observations within the region.

Table A4. 2012 regional average temperature and salinity values for individual cruises that sampled within the northern Mid-Atlantic Bight (boundaries defined in Figure 1.) Average values incorporating less than 10 observations are shown in gray.

Northern Mid Atlantic Bight

Cruise	CD	#obs	Surface Temp	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Temp	Anomaly	SDV1	SDV2	Flag
DEL1201	21	1	13.12	2.76	1.46		1	0					
DEL1202	48	25	7.92	2.64	0.27	1.24	0	20	9.23	3.36	0.31	1.22	0
DEL1203	85	2	8.16	4.37	0.81	0.19	1	2	7.03	3.80	0.79	0.12	1
HB1201	85	55	8.83	4.16	0.17	1.50	0	46	8.89	3.72	0.22	1.61	0
HB1202	157	32	16.07	2.91	0.24	1.90	0	27	9.28	1.51	0.30	1.69	0
S11201	171	12	16.90	1.83	0.35	0.75	1	12	9.34	1.73	0.35	0.85	1
HB1205	224	44	23.49	3.35	0.21	1.53	0	40	11.50	1.72	0.23	1.36	0
HB1206	273	55	20.14	2.35	0.18	1.36	0	43	13.60	1.05	0.23	2.50	0
PC1207	308	29	15.89	1.55	0.25	1.65	0	25	14.84	1.68	0.28	1.44	0

Cruise	CD	#obs	Surface Salinity	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Salinity	Anomaly	SDV1	SDV2	Flag
DEL1201	21	1	34.77	0.44	0.97		1	0					
DEL1202	48	24	32.85	-0.28	0.19	0.36	0	20	33.36	-0.18	0.18	0.48	0
DEL1203	85	2	32.48	-0.13	0.51	0.22	1	2	32.65	-0.06	0.50	0.00	1
HB1201	85	55	32.66	-0.22	0.11	0.40	0	46	33.29	-0.08	0.13	0.52	0
HB1202	157	32	32.14	-0.26	0.16	0.34	0	27	32.85	-0.49	0.17	0.45	0
S11201	171	12	32.14	0.29	0.23	0.40	1	12	32.64	-0.24	0.21	0.20	1
HB1205	224	44	32.01	-0.35	0.13	0.59	0	40	33.12	-0.13	0.14	0.37	0
HB1206	273	55	33.01	0.37	0.12	0.74	0	43	33.59	0.14	0.13	0.57	0
PC1207	308	28	33.44	0.46	0.17	0.97	0	24	33.90	0.28	0.17	0.37	0

"Cruise", the code name for a cruise:
CD, the calendar mid-date of all the stations within a region for that cruise:
"#obs", the number of observations included in each average:
"Temp", the areal average temperature: "Salt", the areal average salinity:
Anomaly, the areal average temperature or salinity anomaly:
"SDV1",the standard deviation associated with the average temperature or salinity anomaly:
"SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived:
Flag, a value of "1" indicates that a true areal average could not be calculated due to poor station coverage.
The areal averages listed were derived from a simple average of the observations within the region.

Table A5. 2012 regional average temperature and salinity values for individual cruises that sampled within the southern Mid-Atlantic Bight (boundaries defined in Figure 1.) Average values incorporating less than 10 observations are shown in gray.

Southern Mid Atlantic Bight

Cruise	CD	#obs	Surface Temp	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Temp	Anomaly	SDV1	SDV2	Flag
DEL1201	24	26	12.76	3.40	0.28	1.05	1	9	11.02	3.30	0.43	3.29	1
DEL1202	46	43	9.09	3.09	0.21	1.12	0	38	9.59	3.74	0.23	1.37	0
HB1201	71	79	10.51	4.35	0.14	1.55	0	67	9.95	4.05	0.19	1.48	0
UN1201	138	1	19.50	2.68	1.43		1	1	14.51	1.57	1.66		1
HB1202	155	37	19.23	2.38	0.22	1.25	1	35	12.49	3.12	0.24	1.22	1
S11201	168	3	18.42	0.84	0.68	0.19	1	3	10.30	2.89	0.71	1.05	1
HB1205	224	44	25.50	1.41	0.20	2.09	0	41	12.67	0.88	0.22	2.84	0
HB1206	261	93	23.63	1.83	0.14	1.37	0	77	14.63	0.34	0.17	2.67	0
PC1207	318	46	14.01	-0.31	0.19	0.98	1	40	13.92	0.09	0.21	1.36	1

Cruise	CD	#obs	Surface Salinity	Anomaly	SDV1	SDV2	Flag	#obs	Bottom Salinity	Anomaly	SDV1	SDV2	Flag
DEL1201	24	26	34.42	0.20	0.20	0.55	1	9	33.69	0.08	0.27	0.42	1
DEL1202	46	43	32.82	-0.57	0.16	1.23	0	38	33.49	0.01	0.14	0.66	0
HB1201	71	79	32.84	-0.31	0.11	0.84	0	67	33.58	0.13	0.11	0.43	0
UN1201	138	1	30.06	-0.51	1.55		1	1	33.60	0.44	1.18		1
HB1202	155	37	32.27	0.13	0.17	0.53	1	35	33.19	0.00	0.14	0.41	1
S11201	168	3	31.80	0.13	0.51	0.12	1	3	32.54	-0.26	0.44	0.02	1
HB1205	224	44	31.95	0.00	0.15	1.12	0	41	33.37	0.29	0.13	0.79	0
HB1206	261	93	32.48	0.20	0.10	0.81	0	77	33.42	0.23	0.10	0.74	0
PC1207	318	46	32.72	-0.23	0.14	0.70	1	40	33.04	-0.04	0.13	0.54	1

"Cruise", the code name for a cruise:
CD, the calendar mid-date of all the stations within a region for that cruise:
"#obs", the number of observations included in each average:
"Temp", the areal average temperature: "Salt", the areal average salinity:
Anomaly, the areal average temperature or salinity anomaly:
"SDV1",the standard deviation associated with the average temperature or salinity anomaly:
"SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived:
Flag, a value of "1" indicates that a true areal average could not be calculated due to poor station coverage.
The areal averages listed were derived from a simple average of the observations within the region.

Table A6. 2012 Temperature, salinity and volume of the shelf water in the Middle Atlantic Bight during 2012. The shelf water is defined as water within the upper 100 meters having salinity less than 34.

CD	Temp	Temp. Anomaly	Salt	Salt Anomaly	SHW Temp	SHW T. Anom	SHW Salt	SHW S. Anom	SHW Volume	SHW Vol. Anomaly
					MABN					
48	9.44	3.54	33.42	-0.07	8.45	3.73	33.04	-0.08	2122.81	66.62
85	9.34	3.76	33.38	0.05	8.03	3.51	32.82	-0.22	1925.49	-149.53
157	10.79	0.86	32.76	-0.46	10.67	1.37	32.65	-0.18	2394.42	472.39
172	11.93	1.06	32.52	-0.72	11.93	1.63	32.52	-0.28	2131.03	194.79
225	14.42	0.92	33.03	-0.40	14.46	1.41	32.80	0.01	2283.48	393.74
274	16.30	1.35	33.82	0.19	16.20	1.68	32.95	0.05	1477.03	-57.55
308	16.12	1.65	34.06	0.35	15.15	1.24	33.25	0.25	1235.01	-125.51
					MABS					
25	13.33	3.92	34.72	0.51	10.55	4.13	33.42	0.24	1074.45	-87.51
46	10.47	2.03	33.85	-0.28	8.53	3.33	32.86	-0.45	1391.80	197.78
71	10.90	2.98	33.97	0.00	9.35	4.17	33.03	-0.35	1541.50	215.87
155	13.76	2.43	33.16	-0.15	13.57	2.67	32.85	0.22	2552.97	446.30
224	16.41	0.68	33.30	0.03	16.34	1.50	32.73	0.11	2373.91	46.48
261	17.26	0.84	33.76	0.26	18.31	2.03	32.79	-0.14	2002.91	-123.43
318	14.91	0.57	33.72	-0.26	13.77	-0.67	32.75	-0.29	1809.63	231.60

Procedures for Issuing Manuscripts in the *Northeast Fisheries Science Center Reference Document* (CRD) Series

Clearance

All manuscripts submitted for issuance as CRDs must have cleared the NEFSC's manuscript/abstract/webpage review process. If any author is not a federal employee, he/she will be required to sign an "NEFSC Release-of-Copyright Form." If your manuscript includes material from another work which has been copyrighted, then you will need to work with the NEFSC's Editorial Office to arrange for permission to use that material by securing release signatures on the "NEFSC Use-of-Copyrighted-Work Permission Form."

For more information, NEFSC authors should see the NEFSC's online publication policy manual, "Manuscript/abstract/webpage preparation, review, and dissemination: NEFSC author's guide to policy, process, and procedure," located in the Publications/Manuscript Review section of the NEFSC intranet page.

Organization

Manuscripts must have an abstract and table of contents, and (if applicable) lists of figures and tables. As much as possible, use traditional scientific manuscript organization for sections: "Introduction," "Study Area" and/or "Experimental Apparatus," "Methods," "Results," "Discussion," "Conclusions," "Acknowledgments," and "Literature/References Cited."

Style

The CRD series is obligated to conform with the style contained in the current edition of the United States Government Printing Office Style Manual. That style manual is silent on many aspects of scientific manuscripts. The CRD series relies more on the CSE Style Manual. Manuscripts should be prepared to conform with these style manuals.

The CRD series uses the American Fisheries Society's guides to names of fishes, mollusks, and decapod crustaceans, the Society for Marine Mammalogy's guide to names of marine mammals, the Biosciences Information Service's guide to serial title abbreviations, and the ISO's (International Standardization Organization) guide to statistical terms.

For in-text citation, use the name-date system. A special effort should be made to ensure that all necessary bibliographic information is included in the list of cited works. Personal communications must include date, full name, and full mailing address of the contact.

Preparation

Once your document has cleared the review process, the Editorial Office will contact you with publication needs – for example, revised text (if necessary) and separate digital figures and tables if they are embedded in the document. Materials may be submitted to the Editorial Office as files on zip disks or CDs, email attachments, or intranet downloads. Text files should be in Microsoft Word, tables may be in Word or Excel, and graphics files may be in a variety of formats (JPG, GIF, Excel, PowerPoint, etc.).

Production and Distribution

The Editorial Office will perform a copy-edit of the document and may request further revisions. The Editorial Office will develop the inside and outside front covers, the inside and outside back covers, and the title and bibliographic control pages of the document.

Once both the PDF (print) and Web versions of the CRD are ready, the Editorial Office will contact you to review both versions and submit corrections or changes before the document is posted online.

A number of organizations and individuals in the Northeast Region will be notified by e-mail of the availability of the document online.

Research Communications Branch
Northeast Fisheries Science Center
National Marine Fisheries Service, NOAA
166 Water St.
Woods Hole, MA 02543-1026

MEDIA MAIL

Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

NOAA Technical Memorandum NMFS-NE -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

Northeast Fisheries Science Center Reference Document -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review and most issues receive copy editing.

Resource Survey Report (formerly *Fishermen's Report*) -- This information report is a regularly-issued, quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. This report undergoes internal review, but receives no technical or copy editing.

TO OBTAIN A COPY of a *NOAA Technical Memorandum NMFS-NE* or a *Northeast Fisheries Science Center Reference Document*, either contact the NEFSC Editorial Office (166 Water St., Woods Hole, MA 02543-1026; 508-495-2350) or consult the NEFSC webpage on "Reports and Publications" (http://www.nefsc.noaa.gov/nefsc/publications/). To access *Resource Survey Report*, consult the Ecosystem Surveys Branch webpage (http://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/).